National Aeronautics and Space Administration

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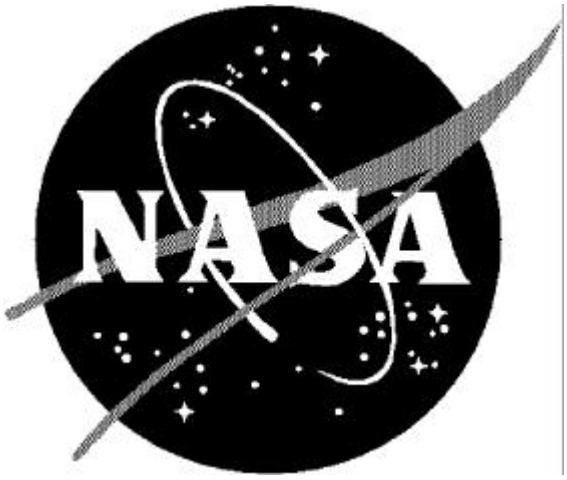

EARTH SYSTEM SCIENCE PATHFINDER MISSIONS (ESSP)

NASA Draft Announcement of Opportunity
Draft

Soliciting Proposals
for
Period Ending
XXXX, 20XX

AO-00-OES-XX
Issued November 2000

Office of Earth Science
National Aeronautics and Space Administration
Washington, DC 20546

Notice of Intent due XXXXXXXX
Proposals Due XXXXXXXX

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EARTH SYSTEM SCIENCE PATHFINDER MISSIONS (ESSP)
Announcement of Opportunity

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APPENDICES

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Earth System Science Pathfinder Mission
Announcement of Opportunity

1.0 DESCRIPTION OF OPPORTUNITY

1.1 Introduction

The National Aeronautics and Space Administration (NASA) announces the opportunity to conduct space missions and acquire the data to understand high priority but least understood Earth System processes, or where we have very limited understanding of the controlling forces on the Earth System and the Earth's response to such forcings.

Additional information on NASA's Earth Science and Applications priorities for this announcement is provided in Section 2, Appendix A and through appropriate links found on the Office of Earth Science homepage at Internet address http://www.earth.nasa.gov.

1.2 Proposal and Evaluation Process

NASA is aware of the significant burdens placed upon the proposing community in responding with detailed proposals to open Announcements of Opportunity. In order to reduce the overall effort expended by the community in preparing full proposals, NASA plans to conduct a two-step proposal and evaluation process for this AO. Step-One is primarily a science concept screening (with some assessment of technical risks) intended to reduce the burden of proposal generation for the proposing community. In the past two ESSP AOs, NASA has selected two primary missions and one alternate mission at the completion of the Step-Two evaluation. For this AO, NASA has altered this approach to select nominally three or four primary missions at the completion of the Step-Two evaluation. Each of these missions will proceed to Mission Design Review (MDR) after which NASA will select nominally two or three missions to enter implementation leading to flight and operations.

1.2.1 Notice of Intent

To assist NASA planning of the proposal evaluation process, NASA strongly encourages all prospective Step-One proposers to submit a Notice of Intent (NOI) on or before the date specified in Section 1.5 in one of the following three ways:

By mail to:

ESSP AO NASA Peer Review Services, Code Y
500 E Street, Suite 200
Washington, DC 20024-2760

Internet at:
The form to submit a NOI can be found on the Internet at: http://essp.larc.nasa.gov/essp

Or by Fax to: 202-479-0511

Principal Investigators whose investigation teams include non-U.S. institutions shall send their NOI to the same address, but shall also send a copy (hardcopy only) to the NASA Office of External Relations at the address specified in Section 4.2.7. In cases where investigators or team members from non-U.S. institutions are to participate, their names, addresses and affiliations shall be included in the Notice of Intent, even if the details of their participation cannot be formalized by the deadline for receipt of the Notice of Intent.

The NOI shall be typewritten in English, no longer than 2 pages and include the following information:

(a) AO Number
(b) Title of the proposed mission
(c) A brief description of the proposed mission goals and objectives
(d) A list of names, addresses, telephone numbers, fax numbers and electronic mail addresses of the following:
- Principal Investigator
- Co-Investigators
- Lead representatives from each organization included in the mission team
- NOI release notice (see Special Notice below)

NASA requests that all NOI be received on or before 4:00 p.m. Eastern Time on the date listed in Section 1.5. NASA will notify proposers that their NOI has been received.

SPECIAL NOTICE: As a result of recent AO's for complete mission investigations such as this one, commercial aerospace and technology organizations have requested access to the names and addresses of those who submit NOIs in order to facilitate informing potential proposers of their services and/or products. As an experiment and at the option of the submitters of a NOI, NASA ESE is willing to offer this service with the understanding that the Agency takes no responsibility for the use of such information. Therefore, all those submitting an NOI in response to this AO are requested to include the appropriately edited form of the following material:

> "By submitting this Notice of Intent to propose, I hereby do / do not authorize NASA to post my name and institutional address (but not the name of my intended proposal) on the World Wide Web starting approximately one week after the NOI due date. If I do authorize such a posting, I understand that such information will be in the public domain, and I will not hold NASA responsible for any use made by others for revealing this information."

1.2.2 Pre-proposal Conference

A pre-proposal conference will be held on the date listed in Section 1.5. The purpose of this conference will be to address questions about the proposal process. The pre-proposal conference will address all those questions received by the Program Executive via fax, mail, electronic mail at the address given in Section 4.2.4, or Internet at http://essp.larc.nasa.gov/essp up to 1 week

prior to the pre-proposal conference (see Section 1.5 for conference date). Additional questions submitted after this date, including those provided in writing at the pre-proposal conference, may be addressed at the conference as time permits. NASA will prepare and post on the ESSP-3 Internet site an "AO Pre-proposal Conference Question Transcript" approximately two (2) weeks after the conference. The conference will be held at [location to be announced in final AO release] from 9:00 am to 3:00 p.m. Additional information concerning the pre-proposal conference is available on the Internet at: http://essp.larc.nasa.gov/essp. Those without Internet access may request this information from the address shown below.

Individuals planning to attend the pre-proposal conference are requested to provide notice to the following address:

By mail to:

ESSP AO NASA Peer Review Services, Code Y
500 E Street, Suite 200
Washington, DC 20024-2760

Internet at:
The on-line forum for submitting questions regarding this AO, and the form to submit attendance plans for the pre-proposal conference, can be found on the Internet at:
http://essp.larc.nasa.gov/essp

Please provide the number of persons attending and the names, addresses and organizational affiliations of the attendees. This information shall be received by no later than one week before the conference in order to facilitate logistical planning.

1.2.3 Two Step Proposal Process

The proposal process is divided into two distinct evaluation steps leading to selection. Those proposals selected must successfully complete the Mission Design Review and the Mission Confirmation Review before proceeding to implementation. Proposers responding to this AO shall first submit a Step-One Proposal with emphasis on the planned science/applications investigation, measurement approach, instrumentation and technical maturity. The Step-One Proposal will be reviewed in accordance with the evaluation criteria in Section 5.1. Evaluation of the Step-One Proposal is intended to assess the in-depth scientific/applications merits, justification, and the maturity of the proposed mission in relation to the science/applications priorities, goals and objectives of the Earth System Science Pathfinder (ESSP) Project and the Earth Science Enterprise. Ratings will be assigned to each Step-One Proposal and provided to the proposer. Based on the Step-One rating, NASA will recommend whether or not a proposer should submit a full Step-Two Proposal. Each proposer will be provided with an assessment of the scientific/applications, along with a high-level technical risk assessment of the mission implementation approach, before submittal of a full Step-Two proposal. No debriefing will be provided until after completion of Step-Two. NASA intends to recommend that only a limited number of highly rated investigations proceed to Step-Two. Missions not recommended to proceed to Step-Two are not prohibited from preparing Step-Two proposals, but should be aware that their proposed science/applications investigation is unlikely to be selected.

Those proposers who choose to continue with the AO process will then be required to submit additional information in the form of a Step-Two Proposal by the date identified in Section 1.5. This proposal shall contain detailed science/applications, technical, cost, management, education and other opportunity information. The Step-Two Proposal will be evaluated in accordance with the evaluation criteria in Section 5.2. NASA will consider only those proposals whose science/applications objectives and methodologies have been evaluated in Step-One. Any proposal whose objectives or methodologies have not been evaluated, including proposals whose objectives or methodologies have changed from Step-One, will not be considered in Step-Two. NASA will make mission selections based on the combined Step-One and Step-Two evaluations as described in Section 5. Those who are selected during the Step-Two evaluation process will receive contracts to perform mission formulation, including risk reduction efforts with an option to proceed into implementation for future flight. The mission formulation phase leading to MDR will be fixed duration efforts. NASA will choose the missions that best complete MDR (see Appendices D and H) and demonstrate retirement of risks to proceed to the Mission Confirmation Review (see Appendices D and H) and implementation leading to eventual flight. At the time of selection to proceed beyond preliminary design and MDR, NASA will assess the funding required for the selected missions against the available profile, and may negotiate any adjustments in mission schedule and launch, and their associated cost impacts, as necessary. Risk retirement, mission maturity, and results of the MDR will be among the factors in determining which missions will be selected to proceed. The mission(s) not selected for implementation will not receive additional funding and may be re-proposed in response to a future AO.

1.2.4 Earth System Science Pathfinder AO-3 Library

The ESSP Library is a resource that was created to provide requirements and background information on the ESSP Project, including science/applications goals, technology and education/outreach strategies, background information on management aspects of flight programs, safety, and launch services. However, it does not contain everything that may be required to develop a proposal. It is the responsibility of the PI to ensure all documents needed are obtained and are the current version. Additional information on the ESSP AO-3 Library is contained in Appendix B.

1.2.5 Notice to Offerors

In the event that a Principal Investigator employed by NASA is selected under this Announcement of Opportunity (AO), NASA will award prime contracts to non-Government participants, including co-investigators, hardware fabricators, and service providers, who are named members of the proposing team, as long as the selecting official specifically designates the participant(s) in the selection decision. Refer to Appendix K, Section L of this AO for proposal information that the selecting official will review in determining whether to incorporate a non-Government participant in the selection decision. Each NASA contract with hardware fabrications and service providers selected in this manner will be supported by an appropriate justification for other than full and open competition, as necessary.

1.3 Commercial, Operational, and International Endeavors Provision

Both national and NASA policy require NASA to support private-sector investment in commercial space activities by committing the U.S. government to purchase commercially available goods and services. In addition, NASA's policy is to work cooperatively with the private sector, other U.S. government agencies and our international partners in the development of a comprehensive capability to observe and understand the Earth. For selected science missions where it can be demonstrated that the data has potential commercial value, NASA is willing to negotiate the data/information rights with interested parties on a case-by-case basis. NASA may also purchase commercial data whenever the commercial data are cost effective and meet NASA's requirements, rather than develop a mission that produces comparable data.

If at the time of proposal evaluation, there is a likely or approved measurement capability similar to that proposed, these policies would preclude selection of that proposal. NASA will select a mission only if the proposer can demonstrate that the proposed mission can deliver science data that does not compete with or duplicate other capabilities. For missions that are similar to existing or planned capabilities, NASA recommends that the proposal include documentation, such as a letter of support, from an appropriate entity responsible for the existing or planned capability indicating their support and agreement that the proposal complements and does not compete with their capability.

Consistent with NASA and national policy, NASA encourages partnership proposals that share investments and benefits. For all such arrangements, NASA will treat the commercial aspects of the mission as contributed capabilities and will evaluate and assess the likelihood of success for the entire mission consistent with the requirements and evaluation criteria described in Sections 3 and 5. For commercial partnerships, these arrangements could include:

- data buy agreements,
- Government financed improvements to commercial systems (e.g., improved calibration, increased storage and downlinking capability),
- shared development of the mission, or
- independent but complementary Government and commercial missions with data sharing agreements.

1.4 Scientific/Applications and Technical Inquiries

Inquiries of a scientific/applications, technical or programmatic nature shall be directed to the ESSP Project Coordinator.

By mail to:

ESSP AO NASA Peer Review Services, Code Y
500 E Street, Suite 200
Washington, DC 20024-2760

Internet at:

The on-line forum to submit and discuss scientific, technical or programmatic issues and inquiries can be found on the Internet at: http://essp.larc.nasa.gov/essp

1.5 Proposal Opportunity Period and Schedule

The opportunity described here is for a two step proposal selection cycle, according to the nominal schedule shown below:

Date of AO release	March 21, 2001
Pre-proposal Conference	April 18, 2001
Notices of Intent due	April 24, 2001
Step-One Proposals due	May 22, 2001
Release of Step-One ratings	July 10, 2001
Step-Two Proposals due	November 7, 2001
Non-U.S. Letters(s) of Endorsement due	December 6, 2001
Planned Site Visits	January, 2002
Announcement of selections	March, 2002

2.0 RESEARCH OBJECTIVES

2.1 Programmatic Context

The mission of NASA's Earth Science Enterprise (ESE) is to develop a scientific understanding of the Earth system and its response to natural or human-induced changes, thereby improving the predictive capabilities for climate, stratospheric ozone, weather, and natural hazards. Through its science research programs, the ESE aims to acquire a deeper understanding of the components of the Earth system and their interactions. These interactions occur on a continuum of spatial and temporal scales ranging from local and regional to global scales and from short-term weather to long-term climate scales. The Enterprise also seeks to provide accurate assessments of changes in the chemical composition and physical state of the atmosphere; in the extent and health of the world's forest, grassland, and agricultural resources; and in geologic phenomena that lead to natural hazards.

NASA shares with other US Global Change Research Program (USGCRP) partners an interest in fundamental studies of the basic processes that govern the Earth system, diagnostic studies of recent and past satellite data records, and model simulations/predictions of global changes. At the same time, effective use of resources requires that the ESE's science strategy be focused on research projects that allow optimal use of NASA's unique capabilities. Compared to the range of investigations embraced by the entire USGCRP, NASA's Earth science program emphasizes measuring changes in forcing parameters, and documenting the natural variability of the Earth system and responses to forcings, especially through space-based measurements. Space-based measurements can provide global coverage, high spatial resolution, and/or temporal resolution, in combinations that cannot be achieved by conventional observational networks.

The *Research Pathways* report (NRC, 1999a) formulated a wide range of research imperatives and scientific questions that require investigation across the field of Earth system science. Choosing among all potentially important research questions is a judgment of scientific value. In the context of NASA's Earth science research program, the principal scientific priority criteria are the spatial scale, temporal duration, and the nature and magnitude of the phenomena being investigated, as well as anticipated return in terms of reducing the uncertainty in understanding and documenting potential changes in the Earth system.

Research questions that address Earth system dynamics at ***large regional to global scales*** are those of greatest interest for the ESE. This is particularly true for regions where only limited conventional (non-space) observations are available (e.g., the atmosphere over the open ocean and polar regions, continental ice sheets, etc.). For example, ESE's atmospheric chemistry research has been focused on global scale chemical processes rather than local air quality, which is typically the responsibility of regulatory environmental agencies.

Likewise preference is given to the study of phenomena and processes that may induce lasting changes in the Earth system, typically ***seasonal and longer period responses***, as well as changes that are irreversible in the foreseeable future. Understanding and predicting fast processes (e.g., the development of weather systems, trace gas emissions) may be essential in order to quantify longer-term average impacts. While forecasting individual environmental phenomena is not a primary ESE objective, further developing experimental prediction of specific events (e.g., weather disturbances) that can be verified by observation is a fundamental research tool for understanding changes in climate and the global environment (e.g., mean displacement in storm tracks). At the process level, priority is given to those processes that have the potential to induce ***large impacts*** and/or are the root of large uncertainty in the overall response of the Earth system.

NASA is a research and development agency, dedicated to maintaining leadership in space research, technology, and missions. Common to all NASA Enterprises is the objective of introducing technical innovations in sensor and platform design, and integrating these new capabilities in flight mission programs. Although not the place to develop new technology, NASA's research and development mission guarantees a strong commitment to expanding knowledge of the Earth through new types of global environmental observations. Investigators seeking to develop new technologies or whose mission concepts do not meet the mission readiness constraint described in section 3.1.2 are encouraged to consider proposing to NASA technology development competitions, such as those for the New Millennium Program (NMP) or the Instrument Incubator Program (IIP).

NASA initiated the Earth System Science Pathfinder (ESSP) project to provide a flexible opportunity to stimulate new scientific understanding of the global Earth system by encouraging innovation in instrumentation and strategies for acquiring and distributing new datasets. The program seeks to reward creativity in all aspects of mission development and to encourage increased participation and innovative ideas in studies of interactions of components of the Earth system and in measurements of key variables from space. The philosophy behind ESSP embraces small satellite missions addressing high priority Earth System Science objectives where the scientific focus of the program will naturally evolve with our enhanced understanding. Thus, the strategy for this ESSP AO is to solicit unique Earth Science missions that address one

or more of the unanswered science questions in the NASA Earth Science Research Strategy for 2000-2010.

ESSP is a science-driven project intended to identify and develop low-cost, quick turnaround spaceborne missions. The National Academy of Sciences (NAS) recommended that ESSP pursue scientific objectives that are not being directly addressed by current or approved programs (NAS/NRC document FO-2080, 1995). As such the ESSP Project is intended to address exploratory measurements which can yield new scientific breakthroughs and can deliver conclusive scientific results addressing a focused set of scientific questions. In some cases, this may involve measuring several related parameters to allow closure tests to be carried out. In other cases, an exploratory mission may focus on a single pioneering measurement that opens a new window on the behavior of the Earth system.

It is the goal of the ESSP Project to sustain a launch rate of at least one mission per year. As such, ESSP will provide periodic windows of opportunity to accommodate new scientific priorities by conducting a series of focused missions to answer critical Earth System Science questions not currently addressed NASA's Earth Science Enterprise. By conducting ESSP missions on a regular basis, NASA provides a mechanism to continuously enhance Earth Science and Applications Programs that are evolving based on new knowledge and changing national priorities.

2.2 Scientific Questions

Establishing research priorities becomes a major challenge when priorities cross a number of different disciplines, each embracing a large set of scientific questions. The challenge facing the ESE is to balance competing demands in the face of limited resources and chart a program that addresses the most important and tractable scientific questions and allows optimal use of NASA's unique capabilities for global observation, data acquisition and analysis, and basic research. To this end, choices need to be made between many projects, all of which are important, timely, and ready to succeed. Most significant from a strategic perspective are the choices between different but equally promising candidate space flight missions or measurement systems.

Thus, NASA's selection of priorities involves both scientific needs and implementation realities. Scientific considerations are paramount and start the prioritization process. These considerations determine what science questions, and ultimately which missions and research projects shall be pursued. Purely scientific considerations are followed by considerations of science-related context (e.g., benefit to society, mandated programs), followed in turn by implementation considerations. The latter, such as technology readiness, tend to influence the order in which science projects are pursued and the final shape they may take. These practical considerations often result in some feedback and iteration of project selection.

The key research topics studied by NASA's Earth Science Enterprise fall largely into three categories: forcings, responses, and the processes that link the two and provide feedback mechanisms. This conceptual approach applies to all research areas of NASA's Earth Science program. The scientific strategy to address this complex problem can be laid out in five fundamental questions, each raising a wide range of cross-disciplinary science problems.

- *How is the global Earth system changing?*
- *What are the primary forcings of the Earth system?*
- *How does the Earth system respond to natural and human-induced changes?*
- *What are the consequences of change in the Earth system for human civilization?*
- *How well can we predict the changes to the Earth system that will take place in the future?*

While these five questions define a logical progression in the study of global change, each one covers a range of topics too broad to serve as a simple guide for program implementation. For this purpose, more specific research questions need to be formulated and prioritized. The ESSP Project is designed to both complement and extend the existing ESE flight program strategy. This third ESSP AO seeks to address the following Earth science research priorities and associated questions based on a logical progression of our current understanding.

Earth System Variability and Trends

- How are global precipitation, evaporation, and the cycling of water changing?

Primary Forcings of the Earth System

- What trends in atmospheric constituents and solar radiation are driving global climate?

- How is the Earth surface being transformed, and how can this information be used to predict future changes?

Earth System Responses and Feedback Processes

- What are the effects of clouds and surface hydrologic processes on climate change?

- How do ecosystems respond to and affect global environmental change and the carbon cycle?

- How can climate variations induce changes in the global ocean circulation?

- How do stratospheric trace constituents respond to change in climate and chemical composition?

- How is global sea level affected by climate change?

- What are the effects of regional pollution on the global atmosphere, and the effects of global chemical and climate changes on regional air quality?

NASA will consider scientifically compelling proposals based on other scientific questions, but proposers shall provide a clear and concise justification in the Step 1 proposal.

These research priorities encompass the traditional disciplines of atmospheric chemistry and physics, solid Earth, oceans and ice, ecosystems, natural hazards, and applications, and are intended to impart a problem focus on the satellite observational activities conducted under the aegis of NASA's Earth Science Enterprise**.**

The initial ESSP Announcement of Opportunity emphasized scientific investigations within all areas of Earth System Science. However, the offerors had to demonstrate that the proposed investigations complemented NASA's existing and/or approved flight program, which was largely embodied by the Earth Observing System (EOS). Further, it was intended to encourage missions which could serve as either gap-fillers or which could provide new types of global "foundation" datasets. The second ESSP Announcement of Opportunity reflected the approaching launch of the initial EOS missions and the continuing development of the missions selected in the first ESSP AO. While not precluding innovative proposals for missions that address critical issues in areas for which there are approved flight programs, the second AO sought unique missions that demonstrate a scientific focus clearly beyond the scope of existing programs.

This ESSP Announcement of Opportunity seeks unique missions that demonstrate a scientific focus on priority areas identified above and are clearly beyond the scope of existing and/or approved missions. NASA will consider proposals based on other compelling scientific questions/priorities, however it remains up to the proposers to articulate the overall scientific benefit of any missions that seek to improve upon planned measurement sets.

ESSP missions are intended to be science-driven. Proposers are required to quantify how the new observations will contribute to the state of knowledge toward one or more chosen science questions by means of a sensitivity analysis and science traceability matrix that illustrate the anticipated improvements in the state of knowledge/understanding as a result of reductions in uncertainty.

The NASA Earth Science Enterprise integrates a broad suite of observational and monitoring objectives in the context of the USGCRP. Specific program elements are summarized in several key science documents (see Appendix B: "Contents of the ESSP AO-3 Library").

The following Internet World-Wide-Web Homepages (URL addresses) may provide additional information of interest:

NASA Earth Science Enterprise Homepage: http://www.earth.nasa.gov/
NASA ESE Missions: http://www.earth.nasa.gov/missions/index.html
ESSP Project Homepage: http://essp.gsfc.nasa.gov
ESSP-3 Announcement of Opportunity Homepage http://essp.larc.nasa.gov/essp
EOS Project Office Homepage: http://eospso.gsfc.nasa.gov/
NASA's New Millennium Program: http://nmp.jpl.nasa.gov/index_flash.html

In summary, the ESSP Project is designed to augment the global measurement objectives of the USGCRP as well as other strategic Earth Science objectives outlined by the National Academy of Sciences. As such, the ESSP Project seeks to:

- Provide new observations that will contribute to the state of knowledge toward one or more chosen science questions

- Provide space based measurements complementary to those directly supported by the NASA Earth Science baseline missions (i.e., EOS and Earth Probes observational data sets)

- Avoid duplicating observational objectives currently supported by means of existing NASA Earth Science Missions (e.g., GRACE, CloudSat, PICASSO-CENA, etc.)

- Avoid duplicating observational objectives supported by existing or approved commercial, national, or international global Earth Science Missions (e.g., Ikonos, POES, GOES, ADEOS II, ALOS, ENVISAT, METOP, etc.)

2.3 Announcement Objectives

This AO invites proposals for the next set of ESSP missions. Proposals are invited for complete investigations of significant Earth System Science questions that meet the objectives of the NASA Earth Science program defined above.

Only proposals to execute complete flight missions through archival and dissemination of data to the scientific community will be accepted. Proposals describing only portions of a mission or that do not address all phases from definition through operations and delivery of data will be deemed not responsive to the AO and will be returned to proposers prior to evaluation. Even if elements of the proposed mission are contributed or commercially provided, as in a data buy arrangement, these elements must be described in your proposal in order to allow NASA to assess the risk of successful implementation and delivery of the data. NASA will evaluate all aspects and elements of the mission against the criteria in this announcement.

The objective of this announcement is to select and fund through launch and science data archival and dissemination, nominally two or three new ESSP missions. Nominally, three or four proposals will be selected and funded for mission formulation, i.e., mission definition, preliminary design, and risk reduction activities. At the end of formulation, NASA will conduct a Mission Design Review (MDR) for each mission. Upon completion of the MDR, NASA will select nominally two or three missions to proceed with a Mission Confirmation Review (MCR) and possible implementation leading to eventual flight.

3.0 PROGRAM CONSTRAINTS, GUIDELINES AND REQUIREMENTS

For ESSP missions, the responsibility and authority to implement the mission rests with the Principal Investigator (PI) and the team that he/she chooses to support him/her. Consistent with the past ESSP missions, the PI's team will have a large degree of freedom in accomplishing mission objectives within the stated constraints. However, to promote teamwork between the PI's team and NASA and to ensure mission success, there will be appropriate Government

oversight and insight. Once a mission has been selected, failure to maintain satisfactory progress on an agreed to schedule or failure to operate within the constraints outlined below may be cause for termination of the investigation by NASA.

Every aspect of the proposed mission shall reflect a commitment to mission success, while keeping total mission costs low. Each component of a proposed mission, from the mission design to the selection of the launch service, to the approach to mission operations, will be evaluated on that basis. Consequently, missions shall be designed and scoped to emphasize mission success within cost and schedule constraints by incorporating sufficient performance margins, cost and schedule reserves, and content resiliency via descoping options.

Only those missions whose scientific objectives are deemed of highest priority, with relatively low implementation risk, and whose proposed implementation cost and definition/development schedules are within the constraints and guidelines identified herein will be considered as candidates for selection. NASA encourages and favors low cost missions that can demonstrate high science value in order to enable more frequent and diverse missions.

NASA's Earth Science Enterprise has adopted commercial data purchases as a mainstream way of acquiring research-quality data, as these commercial capabilities become available. NASA encourages the use of commercially available data sets by PIs as long as it meets the scientific requirements and is cost-effective. If applicable, the proposer shall identify the commercial data sources intended for use and the associated cost. If a data buy is proposed all sources will be evaluated as if it is a proposed mission consistent with the evaluation criteria in Section 5.

The following sections describe the constraints, guidelines and requirements for missions selected through this announcement. Specific information, directions, and requirements for Step-One and Step-Two proposal preparation and evaluation are included in Sections 4 and 5 and Appendix K.

3.1 General Program Constraints

3.1.1 Available Funding

The ESSP Project represents an effort by NASA to develop and implement a program of small, frequent, high-value Earth science/applications missions. To this end, NASA will limit the NASA funding for the mission selected under this AO. NASA encourages but does not require contributions from sources other than NASA. NASA has no limit on the size of the contributions, but will assess the contributed aspects of the proposal against the same criteria as the NASA funded aspects.

For each proposed mission, the total available NASA Earth Science Enterprise Cost ceiling is $125 million (including the costs through MDR, but not including the NASA Launch Service Cost). The Step-Two proposal shall include a commitment by the proposer to accomplish the mission within the proposer's Earth Science Enterprise Cost cap, which shall be less than or equal to the ESE Cost ceiling. The proposed NASA Mission Cost (NMC) is the sum of the proposed NASA Earth Science Enterprise Cost Cap and the proposed NASA Launch Services

Cost. The proposed Total Mission Life Cycle Cost is the sum of the proposed NASA Mission Cost and the cost of all proposed Contributions.

3.1.2 Mission Readiness

The ESSP Project provides a mechanism to accomplish important scientific/applications investigations within a reasonable development period. Therefore, all proposed missions shall be of sufficient technical maturity to achieve launch readiness within a nominal goal of 36 months after receiving the authority to proceed into the Mission Confirmation Review (MCR) and mission implementation. NASA has placed no absolute time constraint upon the duration of mission operations, although the proposal should provide the scientific/applications and cost-based justification of the proposed mission duration.

3.1.3 Mission Options

It is NASA's intention to give the proposing community broad flexibility in developing ESSP mission options. ESSP missions may use data buy agreements, NASA financed modifications to commercial systems, payloads attached to the International Space Station (ISS), in the Space Shuttle cargo bay, or to other spacecraft busses, or free-flying spacecraft launched from expendable launch vehicles or the Space Shuttle. The ISS opportunities include external attached payloads intended for the EXPRESS (EXpedite the PRocessing of Experiments for the Space Station) Pallet and internal pressurized payloads intended for the Window Observational Research Facility (WORF). EXPRESS Pallets are anticipated to launch in 2004 and 2005 and WORF opportunities are anticipated to begin in 2002 or 2003.

NASA envisions a time when the majority of services required to implement missions are available in a “catalog” mode, leaving the investigator free to focus on the aspects of the mission that are unique to the scientific objectives. As steps towards this end, and to facilitate broad flexibility on the part of the community in developing ESSP mission options, NASA has made available a number of services. With the exception of NASA provided launch services, proposers are free to use all, some, or none of these services. The proposal must contain the same level of detail in describing all aspects of the planned mission, whether aspects of the mission are obtained from NASA or from other sources.

As a service to the community, the Rapid Spacecraft Development Office (RSDO) provides a “catalog” of spacecraft buses. Use of RSDO services is at the discretion of the proposer. Further information on the RSDO is available through the ESSP AO-3 Library, Appendix B.

Tracking, control, communications, and other operations services are available through the Space Operations Management Office (SOMO). As a matter of NASA policy, proposers selected through this announcement should be prepared to support tradeoff studies on the use of NASA-provided operations services verses proposed alternatives, during the Mission Definition and Preliminary Design phase leading to the Mission Definition Review. General NASA guidance is that NASA-provided operations services be employed whenever they meet mission objectives at a cost less than or equal to any proposed alternatives.

3.1.4 Launch Services

Unless contributed, NASA will provide the launch services required by the selected missions. The PI must propose a launch option that supports the proposed mission. If the launch option is NASA funded, it must be from the following list. This list is based upon the launch options available through NASA at the time of the release of this AO for a NASA Launch Cost ceiling of approximately $50M. Please note that while NASA will fund and provide these launch services separately, we will consider and evaluate the NASA Launch Services Cost as part of the total NASA Mission Cost. All launch services shall be costed in the proposal even if funded by NASA. If a mission is selected, NASA reserves the right to investigate alternative launch strategies (i.e., other launch services, shared manifest on an expendable launch vehicle, etc) and therefore may require additional launch trade studies during the formulation phase of the selected mission. Additional information is contained in Appendices C and D. The following types of NASA funded launch services may be proposed:

- Space Shuttle
- International Space Station
- Taurus 2210
- Taurus 2110
- Pegasus XL
- One half of Delta II 2320

The following applies to contributed launch services. The National Space Transportation Policy states: "For the foreseeable future, United States Government payloads will be launched on space launch vehicles manufactured in the United States, unless exempted by the President or his designated representative." The policy allows the exception: "This policy does not apply to use of foreign launch vehicles on a no-exchange-of-funds basis to support the following: flight of scientific instruments on foreign spacecraft, international scientific programs, or other cooperative government-to-government programs. Such use will be subject to interagency coordination procedures." This exemption may not apply to all contributions of foreign launch services, such as contributions from private or commercial entities that are not subject to interagency coordination procedures. For example, a private U.S. company, seeking to contribute accommodation of an ESSP payload on an U.S. manufactured, privately owned commercial satellite, will need a waiver of this national policy if the launch vehicle is not manufactured in the United States.

If a proposal submitted in response to the ESSP AO requires that NASA consult with the Office of Science and Technology Policy regarding consistency with National Space Transportation Policy, NASA will not reject the proposal for this reason. If such a proposal is selected for funding, the NASA Office of Earth Science will request that the NASA Office of Space Flight initiate formal coordination with the White House Office of Science and Technology Policy (OSTP) regarding the proposed mission concept. However, NASA will not approve a mission for implementation without the OSTP discussion being complete on or before the time of the Mission Definition Review. NASA cannot guarantee that OSTP concurrence will be provided for any given mission. In the event that a mission cannot be approved for implementation for this reason, the Government has no liability. The proposing team assumes the risk of submitting

a proposal that is conditioned upon obtaining OSTP approval to use a foreign launch vehicle for NASA-funded payloads.

For more information on the National Space Transportation Policy, see the August 5, 1994 Fact Sheet - Statement on National Space Transportation Policy.

3.2 General Program Guidelines

For the purposes of this AO, mission phases are defined as follows:

Phase 1: Mission Concept Studies
Phase 2: Mission Definition and Preliminary Design
Phase 3: Mission Detailed Design
Phase 4: Mission Development and Launch
Phase 5: Mission Operations and Data Analysis, Archival, and Dissemination

Generally, Phases 1 and 2 occur during mission formulation while Phases 3, 4, and 5 are performed during mission implementation (See NASA Document NPG 7120.5A).

3.2.1 Mission Teaming

ESSP mission teams shall be led by a single Principal Investigator who may be from any U.S. or non-U.S. organization including educational institutions, industry, nonprofit institutions, NASA Centers, Federally Funded Research and Development Centers (FFRDCs) and Government agencies. The PI is responsible to NASA for the scientific integrity of the mission, as well as the management of the complete mission. Teaming and partnership arrangements among these organizations are encouraged. Co-Investigators, and co-PIs (if any), shall have an identified role in the proposal, play a defined and necessary role in the investigation, and be covered in the funding plan. Teams are encouraged to use U.S. commercial suppliers, commercial off-the-shelf technology, and other arrangements to support U.S. industry to the greatest extent practical.

If included in your proposal, NASA institutional services shall be proposed on a full-cost accounting basis through teaming arrangements between the mission team and NASA centers. In such cases, it is the team's responsibility to contact the appropriate NASA organization directly and provide endorsements from the NASA organization. The Office of the Chief Financial Officer at a NASA field center can provide assistance with full-cost accounting issues.

3.2.2 Contributions

Contributions of any kind, whether cash or non-cash (property and services) are encouraged but not required. There is no limit on the amount of contributions. Contributions are defined as any portion of a mission provided on a no-exchange-of-NASA-funds basis. Such contributions may be applied to any part, or parts, of a mission, and may be from U.S. companies, U.S. Government agencies, and/or international participants (see Section 3.3). For commercial partnerships, these contribution arrangements may include the commercially funded portions of data buy agreements, Government financed improvements to commercial systems, shared development of the mission, or independent but complementary Government and commercial missions with data

sharing agreements. NASA Center civil service or support contractor resources (manpower, facilities or hardware) may not be contributed, unless they are being separately funded for an effort complementary to the proposed investigation.

Values for all contributions of property and services shall be established in accordance with applicable cost principles and included in the proposed Total Mission Life Cycle Cost (TMLCC), which is the sum of the NASA Mission Costs (NMC) and all contributions. The cost of contributed hardware shall be estimated as either (1) the cost associated with the development and production of the item if this is the first time the item has been developed and if the mission represents the primary application for which the item was developed; or (2) the cost associated with the reproduction and modification of the item (i.e., any recurring and mission-unique costs) if this is not a first-time development. If an item is being developed primarily for an application other than the one in which it will be used in the proposed investigation, then it may be considered as falling into the second category (with the estimated cost calculated as that associated with the reproduction and modification alone). The cost of contributed labor and services shall be consistent with rates paid for similar work in the offeror's organization. The value of materials and supplies shall be reasonable and not exceed the fair market value of the property at the time of contribution.

NASA will assess the entire mission, including all contributions, against the criteria in this AO. Proposed contributions, including commercial partnership arrangements, shall be described in sufficient detail to allow an assessment of the adequacy of the contribution to fulfill the commitment made. This includes the provision of all requested technical, cost, schedule, and management data in the proposal and subsequent reviews. Failure to document all technical, cost and schedule data, management approaches and techniques, and the commitment of all contributing team partners, may cause a proposal to be found non-responsive to this AO and dropped from further consideration. If NASA selects a mission with domestic contribution arrangements, the appropriate agreements and/or contracts shall be signed and copies delivered to NASA within 90 days of award of NASA mission contract.

3.2.3 Data Dissemination

U.S. Government information shall be disseminated without restriction at no more than the cost of dissemination. Therefore, data from Earth Exploratory Mission funded by the U.S. Government will be distributed in the same way as other NASA Earth Science Enterprise data (see Section 3.4). However, for data from missions in which there is significant U.S. private sector investment, NASA will consider innovative data management approaches that afford protection of commercial opportunities while still maximizing non-proprietary scientific return. In all cases, the mission science team approved by NASA shall have immediate and complete access to the basic data and products defined and produced by the mission. NASA will consider proposals for non-traditional data distribution arrangements as long as the full data set is ultimately available for long-term archival and open distribution. For data/information having demonstrated commercial value, however, NASA is willing to consider special arrangements on a case-by-case basis. .

3.3 International Participation

Recognizing the potential scientific/applications, technical, and financial benefits offered to all partners by international participation, participation by non-U.S. individuals and organizations as PIs or team members in ESSP investigations is welcomed. Participation by international partners in ESSP missions may include the contribution of all, or a portion of, the scientific/applications instruments, spacecraft, launch services (subject to national Policy constraints), mission operations, mission science (i.e., science/applications team), communications, data processing, etc., on a no-exchange-of-NASA-funds basis. Any proposed international participation shall be described at the same level of detail as that of other partners. This includes the provision of all requested cost, schedule, and management data in the proposal and subsequent reviews. Since participation of a non-U.S. PI in ESSP will be on a no-exchange-of-funds basis, any non-U.S. PI shall arrange with an U.S. co-investigator to fund U.S. participants under the proposal.

Although NASA-provided dollars may not be used to fund non-U.S. PIs or mission team members, the direct purchase of goods and/or services from non-U.S. sources by U.S. team members is permitted but is subject to federal trade laws and regulations. Potential ESSP participants are advised that international purchases made using funds derived from NASA shall meet NASA and Federal regulations and that these regulations will place an additional burden on investigation teams that shall be explicitly included in discussions of the investigation's cost, schedule, and risk management. Information regarding regulations governing the procurement of foreign goods or services is provided in Appendix E.

All Step-Two proposals for missions with non-U.S. participants (other than Co-Investigators as discussed below) shall include a draft Memorandum of Understanding (MOU) between the Principal Investigator and each non-U.S. organization. Principal Investigators are urged to contact NASA's Office of External Relations (see paragraph 4.2.7) for guidance with international affairs. The draft MOU is not required to be signed at the time of the Step-Two proposal, but shall be representative of the terms and conditions under which mission team members would operate. The MOU shall clearly identify the role of the two parties in the proposed mission and the resource(s) being provided, and shall clearly commit and make available all identified resources to the mission by an identified time that is compatible with the mission's proposed milestones. Model MOU language can be found in Appendix F. MOUs do not count as part of the page limit for Step-Two proposals.

Non-U.S. institutions providing only Co-Investigators are not required to submit an MOU, but shall submit a commitment letter. The Letter of Commitment shall clearly identify the intended role of the organization in the proposed mission and the resource(s) being provided, and shall clearly commit identified resources to the mission upon selection as an ESSP mission. The Letter of Commitment shall be signed by an official with the authority to commit his/her organization's resources. Letters of Commitment do not count as part of the page limit for Step-Two proposals.

All agreements with non-U.S. partners or U.S. co-PIs shall be finalized and signed no later than the Mission Design Review. Failure to provide such agreements in the time allotted may result in the de-selection of the investigation.

3.4 Science/Applications Requirements

Proposals submitted in response to this AO shall cover the entire mission. This includes definition, development, launch, mission operations, necessary in situ measurements, data processing, data archival, dissemination of data into the public domain, and preparation of adequate documentation and ancillary data for analysis by scientists other than those participating in the prime mission phase. All ESSP missions shall comply with the guidelines outlined in Appendix G, in order to ensure timely community-wide access to reduced data products. As such, there will be no proprietary data rights allowed, except as discussed in Section 3.2.3. ESSP mission teams will be responsible for collecting the scientific/applications, engineering, and ancillary information necessary to validate and calibrate the scientific/applications data before making it available to the scientific/applications community and, ultimately, the public. The ESSP mission evaluation process will reward those proposals that outline procedures for minimizing the time between data acquisition and data dissemination.

ESSP PIs are required to publicize their products and data services to the broader Earth Science community via the Global Change Master Directory (GCMD). PIs will ensure population of the GCMD with appropriate information on their instrument and data products and services, and provide pointers to their World Wide Web (WWW) page or other client interface for search and access. All data set descriptions should be provided as Directory Interchange Format (DIF) entries, which are automatically compliant with the Federal Geographic Data Committee (FGDC) standard for geospatial data. The content for DIFs can be easily submitted through the DIFbuilder tool, available at http://gcmd.nasa.gov/difbuilder. Descriptions for related data tools or services should be provided as Services Entry Record File (SERF) entries, for which the content can be submitted through the SERFbuilder tool, available at http://gcmd.nasa.gov/serfbuilder. Contact the GCMD User Support Office at http://gcmduso@gcmd.nasa.gov/ for assistance.

To facilitate access to ESSP data by the Earth Science community, NASA recommends that ESSP missions produce data products in a core NASA-provided or community-endorsed format compatible with the research community that will use the data. NASA also recommends that ESSP missions generate and store metadata describing their data products that will facilitate user search and order, and user understanding of product quality and utility. Further information on data archival and access, and on data and metadata standards, is found in Appendix G.

In addition to the available funding described in Section 3.1.1, NASA intends to allocate resources to fund a post-launch Science Data Analysis Program (SDAP) for broad scientific studies of the Earth using newly generated ESSP data sets. As an ESSP mission nears launch, and periodically thereafter, NASA will solicit proposals for investigations under the SDAP via NASA Research Announcements (NRA's).

ESSP mission science/applications teams shall succinctly define the scientific/applications objective of the proposed mission and the scope of their efforts for the active data collection phase of their mission. It is anticipated that the PI and the science/applications team will focus their efforts on data acquisition, calibration, validation, and initial scientific/applications

evaluation in support of their proposed research objective(s). The follow-on SDAP, which will be open to all parties interested in ESSP mission data sets, will focus upon additional interpretation and correlative analysis activities. While the science/applications team is encouraged to analyze and publish interpretations of mission flight data as it becomes available during the course of the active mission, it shall be understood that community-wide analysis of the reduced (i.e., validated and calibrated) data sets provided by each ESSP mission will be largely supported by the follow-on SDAP. Therefore, mission science/applications team members shall have clearly defined roles during the pre-flight development and flight mission data acquisition, calibration, validation, and initial scientific evaluation activities.

Some ESSP missions may require supporting aircraft remote sensing under-flights and ground calibration activities. NASA recognizes that these can be critical elements of overall ESSP missions and, if required, they should be fully described and costed in proposals submitted in response to this AO.

Every ESSP mission proposed in response to this AO shall identify both a "Baseline Science/Applications Mission," a "Minimum Science/Applications Mission," and an associated descope plan. The Baseline Science/Applications Mission refers to that mission which, if fully implemented, will accomplish the entire set of scientific/applications measurement objectives identified for the mission at the initiation of formulation. The Minimum Science/Applications Mission is defined as the minimum science/applications accomplishment (i.e., measurement set) below which the mission will not be considered justifiable for the proposed cost.

Any alteration of the mission that results in a reduction of the mission's ability to accomplish the Baseline Science/Applications Mission set of scientific objectives as identified at the Step-Two award will be considered a "de-scoping" of the mission. NASA and the PI will review the resulting set of achievable scientific/applications objectives to ensure that the mission remains at or above the Minimum Science/Applications Mission. The peer review and technical evaluation of Step-Two proposals will determine the science/applications return of both the Baseline and Minimum Science/Applications Missions. The differences between the proposed Baseline and Minimum Science/Applications Missions will be assessed in the Step-Two process to determine mission resiliency in the event that development problems require reductions in scope. If the proposed Baseline and Minimum Science/Applications Missions are equivalent, proposers shall clearly articulate the rationale for this decision and identify other viable contingency options in the Step-Two proposal (i.e., additional reserves, etc.). Failure to maintain a level of anticipated science/applications return at or above the Minimum Science/Applications Mission, as determined by NASA, will be cause for termination of the investigation at any time.

3.5 Technical Requirements

ESSP proposals shall include all technical aspects of the investigation from concept definition through mission operations and data analysis, archival, and dissemination (See Section 3.2). ESSP missions shall meet the technical requirements described in the Earth Explorers Program Mission Assurance Guidelines and Requirements and the Earth Explorers Program Flight and Ground Safety Requirements (see Appendices H and J). NASA Procedures and Guidelines (NPG) 7120.5A ("Management of Major System Programs and Projects") delineates activities,

milestones, and products typically associated with mission formulation and implementation and may be used as guidance in defining a team's mission approach. The use of innovative processes, techniques, and activities as well as direct purchase of commercial off-the-shelf (COTS) technology to accomplish objectives is encouraged when cost, schedule, and technical improvements can be demonstrated.

NASA is committed to successfully infusing new technologies that will lower mission costs into its programs. However, the short definition and development time available for ESSP missions generally will not allow for significant technology development after mission selection. NASA expects that the technology-driven activities such as the New Millennium Program (NMP) and Instrument Incubator Program (IIP) will serve as the primary technology "engines" for future Earth Science Enterprise missions. Any new technology, technology development or technology enhancement required for successful performance of an ESSP mission shall be identified in the proposal, along with the risks involved and alternative approaches to mitigate the risks.

3.6 Cost Requirements

NASA funding of the missions proposed under this AO is limited by the funding identified in Section 3.1.1. Once established for a selected mission, the Earth Science Enterprise (ESE) Cost cap shall assure adequate funds to meet cost-to-complete requirements. Where appropriate, this includes identification of credible, phased schedule and cost reserves, which are proportional to the development risk. The proposed ESE Cost cap will be considered to be fixed and committed at selection. The ESSP Project does not maintain a reserve pool from which missions exceeding their cost commitments may draw.

The proposal shall include the Total Mission Life Cycle Cost (TMLCC) for each ESSP mission, which includes the ESE Cost, the NASA Launch Services Cost, and all contributed costs. The TMLCC includes but is not limited to:

- Mission definition and development of all flight and ground hardware and software, acquisition of launch services, launch, and operations of a mission to observe and understand aspects of the Earth System;
- Accomplishment of any correlative measurements necessary to ensure optimum science return by calibrating or validating these observations;
- Obtaining any support needed from other organizations, missions, or projects;
- Development, operation, refinement, maintenance, documentation, and publication of all required algorithms to accomplish the mission;
- Processing, archiving, distribution, maintenance, documentation, and information management of all mission derived data products consistent with interfaces required to permit community-wide access via appropriate existing mechanisms;
- Publication of results in the refereed science literature;
- Delivery to NASA, at the conclusion of the mission, of all data, supporting information, and available results to facilitate NASA-supported preservation and dissemination;
- Supporting NASA Earth Science Program communication and outreach goals and objectives.

The proposed NMC in Step-Two will be used to assess the science value of the mission. The Step-Two TMLCC will be evaluated to determine the adequacy of the total proposed resources to successfully carry out the mission. While the TMLCC does not enter into the science value assessment directly, contributions should increase the science return of the mission and therefore its science value.

3.7 Management Requirements

The development schedule and budgets associated with ESSP Projects demand innovative business and management practices. NASA's approach to ESSP missions encourages teaming arrangements among industrial, academic, government, and international partners. Selected mission teams will have full responsibility and authority to accomplish the mission. This will permit them to use innovative approaches necessary to stay within the strict cost and schedule limits of the program. NASA oversight and reporting requirements will be at the appropriate level to ensure mission success and agreed-upon science return in compliance with committed cost, schedule, performance, quality, reliability, and safety requirements. Failure to meet negotiated cost and schedule milestones at any stage of the mission may be cause for termination.

Mission teams shall submit, at a minimum, monthly programmatic reports that include significant accomplishments; the status of technical margins; mission risk identification, mitigation tracking and resolution; current schedule margin; and workforce. Mission teams shall provide the Earth Explorers Program Office detailed schedules on a quarterly basis, at a minimum.

Mission teams shall also submit monthly and quarterly (533M and 533Q, or equivalent) financial management reports as described in NPG 9501.2C "Procedures For Contractor Reporting Of Correlated Cost And Performance Data" (23 April 1996). Mission financial management reports shall be prepared according to the WBS and cost element structure contained in the mission proposal unless changes are negotiated and approved after selection. Mission financial management reports shall be required from prime contractors as well as first-tier subcontracts that meet the reporting requirements set forth in NASA FAR Supplement Section 18-42.7201 (b) (1). Mission teams shall also provide funding profiles and explain variances between projected and actual costs, as required during mission implementation. NASA intends to use existing mission team internal management reporting systems to the maximum extent feasible in satisfying mission financial reporting requirements.

ESSP missions shall have a product assurance program that complies with the Mission Assurance Guidelines and Requirements in Appendix H, and that also meets the intent of the ISO 9000 series, American National Standard, "Quality Systems - Model for Quality Assurance in Design, Development, Production, Installation, and Servicing", ANSI/ASQC Q9001-1994. ESSP missions shall also have a mission safety program that complies with the Flight and Ground Safety Requirements in Appendix J.

The required system level reviews for ESSP missions are the System Requirements Review (SRR), Preliminary Design Review (PDR), Mission Design Review (MDR), Confirmation

Readiness Review (CRR), Mission Confirmation Review (MCR), Critical Design Review (CDR), Pre-Environmental Review (PER), Pre-Ship/Operational Readiness Review (PSR/ORR), Mission Readiness Review (MRR), and Flight Readiness Review (FRR). These reviews are described in Appendix H and will be conducted by NASA

The MDR, CRR, and MCR constitute the mission confirmation process. The purpose of the confirmation process is to establish that the Mission Team has completed an acceptable mission formulation and is prepared to begin mission implementation within the identified ESE Mission Cost cap. The MDR will follow the PDR and combine the findings of the PDR with a programmatic and process review of the proposed mission implementation. It provides an independent assessment of mission readiness and identifies the technical, financial, management, and schedule risks associated with successfully completing implementation of the mission. At the conclusion of the MDR, the Associate Administrator for the Office of Earth Science will select those missions that will proceed to MCR and if confirmed to implementation. The CRR examines the MDR results and establishes recommendations on mission confirmation. The MCR serves as a final gate for the mission to proceed into implementation. All of these reviews shall appear in the mission schedule.

In order to assess the progress of the mission and to provide NASA with necessary technical and programmatic insight, the mission team shall also develop and propose a schedule of peer reviews. NASA shall be invited to attend and participate in any peer review that the mission team conducts. The proposer may refer to NASA NPG 7120.5 for guidance in this area. The purpose of these reviews is to assess the technical, management, cost and schedule progress of the mission to ensure that reasonable and sound engineering and management are being employed throughout the mission definition and development cycle. These reviews will provide the mission team with an assessment of the program, provide feedback through recommendations as necessary and indicate any potential problem areas.

The selected mission team will be totally responsible for the ESSP mission, including science/applications integrity and mission implementation. In this “PI-Mode,” the PI and mission team will have full responsibility for all aspects of the mission. This includes instrument and spacecraft definition, development, integration, and test; launch services (if contributed by the mission team) or mission launch interfaces (if launch service is NASA provided); ground system; science operations; mission operations; and data processing, archival and dissemination. Each mission team member shall consider themselves responsible for mission success (i.e., delivery of science data products), rather than solely for their portion of the mission. The PI may select partners from industry, academia, nonprofit institutions, NASA Centers, Federally Funded Research and Development Centers (FFRDC's), other Government agencies, and international organizations to assist in carrying out the responsibility for implementing the mission.

It is the intent of NASA to give the PI and the mission team the ability to use their own processes, procedures, and methods to the fullest extent possible. ESSP mission teams shall define the management and contractual approaches that are best suited for their particular teaming arrangement. These approaches shall be commensurate with the investigation’s implementation approach while retaining a simple and effective management structure necessary to assure the adequate control of development within the cost and schedule constraints.

Contractual approaches are encouraged that provide incentives to team members toward successful delivery of science/applications data products. Team member agreements and/or contracts shall be signed and copies delivered to NASA within 90 days of award of NASA mission contract (see Section 3.3 for international agreements). The investigation team shall develop and propose a Work Breakdown Structure (WBS) to manage mission implementation that best fits their organizational approach and mission design concept. An example WBS may be viewed in the library at http://essp.larc.nasa.gov/essp .

The PI shall be the central person in each ESSP mission, with full responsibility for the scientific/applications integrity of the mission. The PI is responsible for assembling a team to propose and implement the mission. The PI shall be accountable to NASA for the scientific/applications success of the mission. The PI shall be prepared to recommend mission termination when, in the judgment of the PI, the successful achievement of the established Minimum Science/Applications Mission objectives is not likely within the committed cost and schedule reserves. Each selected mission team shall propose and negotiate a set of performance metrics during the Mission Definition and Preliminary Design Phase (phase 2) for program evaluation, including cost, schedule, and technical performance as appropriate. These metrics shall be incorporated into the contract. Violation of the agreed upon metrics, as determined by NASA, may be cause for termination of the investigation at any time.

Each ESSP mission shall have a dedicated Project Manager (PM) reporting directly to the PI, who will oversee the formulation and implementation of the mission. The role, qualifications, and experience of the PM shall be carefully considered to ensure that the programmatic and technical needs of the investigation would be met. The PM and other key individuals, such as a systems engineer, their roles, and the adequacy of their experience shall be identified for each ESSP investigation.

Each ESSP mission shall define the risk management approach it intends to use to ensure successful achievement of the mission objectives within established resource and schedule constraints. In addition, identify any manufacturing, test, or other facilities needed to ensure successful completion of the mission's objectives.

3.8 Educational Requirements

The educational goal of the Earth Science Enterprise is to stimulate public interest in and understanding of Earth system science and encourage young scholars to consider careers in science and technology. All ESSP proposals should include an Education component that addresses one or more aspects of the Earth Science Enterprise educational objectives:

- Informal Education. Increase public awareness and understanding of how the Earth functions as a system and NASA's role in enabling development of that knowledge.
- Formal Education. Enable the use of Earth science information and results in teaching and learning at all levels of education.
- Professional Development. Build capacity for productive use of Earth science results, technology, and information in resolving everyday practical problems.

The phrase, public outreach, is sometimes used in association with education in various parts of NASA. To the extent that its objective is to *enhance public understanding of science and technology* that includes the following elements:

- Appreciation of the relevance and role of science and technology, both, as a *process* and *product*;
- Accessibility of scientific information and learning as a source of empowerment;
- Analysis, evaluation, and decision-making skills; and
- Taking appropriate actions to meet personal and societal needs,

public outreach is considered a part of informal education in the Earth Science Enterprise.

The educational activities shall focus on building the learning continuum from broad-based awareness to enhanced understanding and knowledge that leads to the conscious usage of that knowledge in everyday activities. The proposed activities shall:

- Utilize external partnerships that bring together key expertise and capabilities
- Focus on the interests and needs of the targeted audiences
- Focus on scientific/applications, technological or educational themes related to the mission objective(s), and not on the mission itself
- Build in an evaluation – front-end, formative, and summative – plan with outcome measures to ensure greatest impact
- Articulate a deployment strategy that is either national in scope or can be scaled to national level at little to no additional NASA investment
- Promote the participation of the under-served and underrepresented segments of the population as represented by demographic, social-cultural, and economic variables, and mental and physical abilities
- Leverage and network existing educational activities for economy of cost and increased impact

For informal education, learning venues capable of large impact are encouraged; examples include media programming (radio, television, film, video), print (newspapers, magazines, books), on-line learning providers, museums, science & technology centers, zoos, aquarium, parks with interpretive staff, community or civic groups, etc. Particular emphasis will be placed on engaging new audiences, providing programming support, building synergy between formal and informal educational activities, as well as professional enhancement of informal learning providers and the development of effective science/applications and technology spokespersons among the science and engineering team of the proposed mission.

For formal education, the proposed activities can be in any of the program categories described in the NASA Implementation Plan for Education (http://education.nasa.gov/implan/exec.html). The ESE places particular emphasis on Teacher/Faculty (K-16) Preparation and Enhancement, Curriculum Support and Dissemination, Educational Technology, Support for Underrepresented Groups, and for Systemic Improvement. The content should be in the context of Earth System Science at appropriate educational levels. Proposed activities shall clearly link to national science and technology education standards (including teacher certification) and related standards in geography, environmental sciences, etc., as well as State and local standards, as appropriate.

If the proposed investigation has a significant component addressing applied use of the scientific or technological aspects of the mission results and information, the Education plan may include professional development activities that provide training and support to the targeted users in developing practical tools for solving real world problems. The proposed activities may include technical assistance/services and/or development of ancillary products such as training materials that utilize remote sensing, standards and procedures accompanying the fusion of remote sensing into operational use, dissemination, and systemic improvement of professional networks.

At least 1% of the overall mission proposal budget may be invested in Education. Immediately following selection of investigations, the Education Team, together with the Principle Investigator and the Project Manager, is expected to work with the Earth Science Enterprise Education Implementation Office at the Goddard Space Flight Center, to develop appropriate collaborative activities. The ESE Education Implementation Office is responsible for the coordination and integration of educational efforts across the Enterprise to ensure synergy between the development and delivery of learning experiences across all audiences. The final Education execution plan may be completed during the formulation stage of the selected mission by considering new educational opportunities or unique capabilities and resources identified collaboratively with the ESE Education Implementation Office.

3.9 Other Opportunities

3.9.1 Participation of Small, Small Disadvantaged, and Women-owned Small Businesses, and Minority Institutions

The Step-Two proposal shall provide a summary for the subcontracting plans for Small Disadvantaged and Women-Owned Small Businesses, Minority Institutions, or Veteran Owned Small Businesses and their involvement in the implementation of the investigation. The subcontracting approach should be discussed and shall state subcontracting goals for disadvantaged, women-owned, and veteran owned small businesses, Historically Black Colleges and Universities, and Other Minority Universities.

The proposing institution(s) shall agree to use their best efforts to assist NASA in achieving its goal for the participation of small disadvantaged businesses, women and veteran-owned small businesses, Historically Black Colleges and Universities (HBCUs), and Other Minority Universities (OMUs) including Hispanic serving institutions, and Tribal colleges and Universities in NASA procurements. Investment in these organizations reflects NASA's commitment to increase the participation of minority concerns in the aerospace community and is viewed as an investment in our Nation's future.

NASA contracts resulting from this solicitation which offer subcontracting possibilities, exceed $500,000, and are with entities other than small business concerns, will contain the clause at FAR 52.219-9. Offerors who are selected under the Step-Two Evaluation Process under this AO, and who meet the foregoing conditions, will be required to negotiate appropriate subcontracting plans. Plans for such subcontracting shall be described in the Step-Two proposal and will be evaluated as part of the Step-Two Evaluation Process (see Section 5.2 and 5.3.2). This information in not required for the Step-One proposal.

3.9.2 Commercialization

NASA is committed to enabling the economic and technical competitiveness of the United States through innovative partnerships between public sector programs within its purview and the private sector. This solicitation encourages U.S. commercial sector participation in all areas of proposed ESSP missions including flight and ground segment development, new product or service development based on data derived from the mission, and the production of final scientific reports and public or educational outreach materials. Best available commercial processes, business practices, and technologies are encouraged to optimize the effectiveness of the project and return best value science to the primary investors, the U.S. taxpayers. Examples of commercial benefits to participating companies include new products, refinement of current products and services, and new directions for research and development of commercial offerings.

Although the evaluation process will reward those proposals that include U.S. private sector commercialization as part of the overall mission, proposals that do not include commercial participation will not be penalized.

4.0 PROPOSAL PREPARATION AND SUBMISSION GUIDELINES

4.1 Format and Content

To be considered for selection under this AO each proposer shall submit a Step-One Proposal. General NASA guidance for proposals is given in Appendix I. A uniform proposal format is required from all proposers to aid in proposal evaluation. The required proposal format and contents for Step-One and Step-Two proposals are summarized in Appendix K. Failure to follow this outline may result in reduced ratings during the evaluation process, or in extreme cases, could lead to rejection of the proposal without review.

4.2 Proposal Submission Information

4.2.1 Endorsements and Certifications

All proposals shall include a letter of endorsement from all organizations offering goods and/or services on a no-exchange-of-NASA-funds basis, involved NASA Centers, other government agencies, non-U.S. organizations providing hardware or software to the investigation, the major participants in the proposal, and the launch service provider if the launch service is not provided through NASA. Letters of endorsement shall be signed by institutional or Government officials authorized to commit their organizations to participation in the proposed investigation and shall describe the offered goods/services and their associated cost/value. These officials shall certify institutional support and sponsorship of the investigation, as well as concurrence in the management and financial parts of the proposal. These requirements apply to both Step-One and Step-Two proposals.

4.2.2 Quantity

All proposers shall provide 35 copies of their bound paper proposal, including the original signed proposal, on or before the proposal deadline. The proposals shall be numbered sequentially from 1 to 35 in the upper right-hand corner of the cover page; the original signed proposal shall be number 1. These requirements apply to both Step-One and Step-Two proposals.

4.2.3 Electronic Version of Proposal

Include with your paper proposal an electronic version of your proposal as described in Appendix K. The primary evaluation will be performed using the paper version as submitted. These requirements apply to both Step-One and Step-Two proposals.

4.2.4 Submittal Address

Step-One and Step-Two proposals shall be mailed to the following address:

By mail to:

ESSP AO NASA Peer Review Services, Code Y
500 E Street, Suite 200
Washington, DC 20024-2760

4.2.5 Submittal Deadline

All Step-One proposals must be received no later than 4:00 p.m. Eastern Time on the date specified in Section 1.5. Proposals received after the established closing date and time will be treated in accordance with NASA's provisions for late proposals (NASA FAR Supplement 1815.412, Late Proposals, Modifications and Withdrawal of Proposals).

All Step-Two proposals must be received on or before 4:00 p.m. Eastern Time on the date specified in Section 1.5. Proposals received after the established closing date and time will be treated in accordance with NASA's provisions for late proposals (NASA FAR Supplement 1815.412, Late Proposals, Modifications and Withdrawal of Proposals).

4.2.6 Notification of Receipt

NASA will notify proposers in writing that their Step-One and Step-Two proposals have been received. Proposers not receiving this confirmation within two weeks after submittal of their proposal should contact NASA at the address given in Section 4.2.4.

4.2.7 Submittal of Proposals Involving International Participation

The procedures for submission of proposals with non-U.S. participants are the same as those for strictly U.S. proposals, as previously outlined in this section. Additionally, one copy (over and above the 35 copies identified in Section 4.2.2) of any proposal (both Step-One and Step-Two) that includes non-U.S. participants shall be directly sent to:

Earth Science Division
Code IY
Ref: ESSP AO-XX-OES-XX
National Aeronautics and Space Administration
Washington, DC 20546-0001
USA
Phone: 202-358-0793
FAX: 202-358-2798

5.0 PROPOSAL EVALUATION, SELECTION, AND IMPLEMENTATION

The selection of investigations that best address the research objectives and scientific questions described in Section 2.0 of the AO and that will be successfully implemented is the fundamental aim of the proposal evaluation process. ***While panel reviews will carry considerable weight, NASA reserves the right to make the final selection of proposals based on the needs of the Earth Science Enterprise, the ESSP program and the research priorities stated in the AO.*** The two-step evaluation approach is designed to identify the missions with the best science/applications value to NASA and assess the probability that the proposed investigations can be achieved within established limits of cost and schedule. The information requested will enable the evaluation panel to determine how well each mission team understands the complexity of the proposed mission, its technical risks, and any challenges which require specific action during the mission definition and preliminary design phase. This information will also enable the evaluation panel to rank the proposed investigations, and will provide the necessary discriminators to permit the selection of those proposals which best meet all guidelines and constraints, and which address all elements viewed necessary for mission success.

Evaluation of the Step-One Proposal is intended to assess the in-depth scientific/applications merits, justification and maturity of the proposed investigation in relation to the research objectives and scientific questions described in this AO and the overall research strategy of NASA's Earth Science Enterprise (see Section 2.0 and Appendix A). As such, the Step-One evaluation will consider the proposed scientific/applications justification and Science Traceability Matrix (see Appendix L, Figure L-3) as the basis from which overall scientific merit and ESSP/ESE program relevance are assessed. The Instrumentation Technical Maturity Matrix and any instrumentation heritage and/or precursors will be assessed to determine the maturity level of the proposed instrumentation. The proposed instrumentation will be evaluated for its applicability to the required physical measurements. Proposed missions that seek to address a broad variety of scientific/applications issues at various disparate levels without attempting to resolve a particular issue will be scored lower than focused missions that articulate a well-defined scientific justification by means of the Sensitivity Analysis (Appendix K, Section F) and Science Traceability Matrix (Appendix L, Figure L-3).

The Step-Two Proposal will be evaluated on the mission science, technical implementation, management implementation, cost, and cost realism. NASA will assess the science value of each proposed mission by integrating the science and applications merit and the NASA Mission Cost.

Education and other opportunities will also be evaluated. Dependent upon the number of Step-Two proposals received and available travel funding, NASA plans to use site visits to collect additional information for the Step-Two evaluation. Your Step-Two proposal must identify the single location for the site visit. NASA recommends that you identify a site that you believe will best support demonstration of your readiness to implement the mission.

NASA will negotiate contracts with those proposals selected during the Step-Two evaluation process to perform the Mission Definition and Preliminary Design phase, including risk reduction efforts with an option to proceed into development for future flight. The Mission Definition and Preliminary Design Phase will be fixed duration efforts. The missions that best complete MDR (see Appendices D and H) and demonstrate retirement of risks will be approved to proceed to the Mission Confirmation Review (see Appendices D and H) and, if confirmed, implementation.

5.1 Step-One Evaluation Criteria

The evaluation criteria listed below will be used to evaluate Step-One proposals. All proposals deemed to be compliant would be evaluated and categorized against these criteria. The Step-One criteria cover:

- Scientific/Applications Merit
- Mission Implementation

The scientific/applications merit criteria will be evaluated giving highest weight. The mission implementation criterion is of secondary importance to the scientific/applications merit criteria. The science/applications merit criterion is a measurement of quality and NASA will assign adjectival ratings as shown in Table 5.1-1. The mission implementation criterion is a measure of implementation feasibility and NASA will assign risk ratings as shown in Table 5.1-2.

Table 5.1-1 Adjectival Ratings for Science/Application, Education, and Other Opportunity Merit.

Adjective	Definition
Excellent	A comprehensive and thorough proposal of exceptional merit. One or more major strengths. No major weaknesses or only minor correctable weaknesses.
Very Good	Demonstrates overall competence. One or more major strengths and strengths out balance any weaknesses. Any major weaknesses are correctable.
Good	Reasonable sound response. There may be strengths or weaknesses, or both. As a whole, weaknesses, not offset by strengths, do not significantly detract from the offeror's response. Major weaknesses are probably correctable.
Fair	One or more major weaknesses. Weaknesses have been found that out balance strengths. Major weaknesses can probably be improved, minimized, or corrected.
Poor	One or more major weaknesses which are expected to be difficult to correct, or are not correctable.

Table 5.1-2 Risk Ratings for Technical Implementation, Management, and Cost

Adjective	Definition
Low Risk	No major weaknesses. Has little potential for disruption of schedule, increased cost, and/or degradation of performance. Problems encountered should be manageable with planned cost and schedule.
Medium Risk	Major weaknesses are correctable. There may be strengths or weaknesses or both. As a whole, weaknesses that are not offset by strengths do not significantly detract from the offeror's response. Could potentially encounter some disruption of schedule, increased cost, and/or degradation of performance. Special emphasis and monitoring will probably be able to overcome difficulties.
High Risk	Major weaknesses are not correctable within proposed resources. Likely to cause significant disruption of schedule, increased cost and/or degradation of performance even with special contractor emphasis and close Government monitoring.

5.1.1 Step-One Scientific/Applications Merit Criterion

NASA will use the following to evaluate the Science/Applications Merit Criterion.

- The overall scientific and/or applications merit of the proposed investigation, as measured by
  - The scientific or applications objectives and justification of the proposed investigation relative to the research objectives and scientific questions described in section 2.0 and more generally to the NASA Earth Science research strategy in Appendix A.
  - The coherence of the traceability from the proposed objectives to the measurements required to the instrument functional requirements and the instrument/mission engineering requirements.
  - The scientific resilience of the investigation, as reflected by the assessment of the minimum science mission and the proposed descope options and the sensitivity to and likelihood of reduced performance or shortened mission life if they become necessary.
- The relevance of the proposed investigation to NASA's Earth Science Enterprise research strategy, its science and application priorities, and the specific research objectives of this ESSP AO.
- The uniqueness and innovation of the proposed investigation. This will include the relationship between the proposed investigation and other approved Earth Science missions including NASA, other government, international, and commercial missions.
- The feasibility of the proposed investigation, including maturity of the underpinning research, the feasibility and risk of achieving objectives based on the proposed instrumentation and technical implementation, the risk that the investigation will not meet the objectives as proposed. Note: NASA will assess the capability of the proposed measurement to achieve the objectives under the Science/Applications criterion, and will assess the capability of the proposed instrument to achieve the proposed measurement under the Mission Implementation criterion.
- The ability of the proposed mission to resolve the proposed scientific/applications questions through a focused mission
- The expertise and experience of the senior members for the science and applications team in relation to the proposed science or applications objectives.
- The adequacy of the correlation measurements and validation activities.
- The adequacy of the data processing and distribution plan, including analysis, archiving, and dissemination of data and results.
- Compliance with the guidelines and requirements of the AO.

5.1.2 Step-One Mission Implementation Criterion

NASA will use the following to evaluate the Mission Implementation criterion.

- Mission design, including adequacy, achievability, completeness, and traceability to high level objectives and constraints.
- Instrumentation: Note: NASA will assess the capability of the proposed measurement to achieve the objectives under the science and applications criterion, and will assess the capability of the proposed instrument to achieve the proposed measurement under the technical implementation criterion.
- Compliance with the guidance and requirements of the AO.

- Technology maturity and heritage.
- High level (cost model based) assessment of the non-binding Step-One cost estimate and the risk of exceeding the ESE Mission Cost ceiling, based on the information provided as set forth in Appendix K.
- Mission implementation, including mission size and complexity.

5.2 Step-Two Evaluation Criteria

The evaluation criteria listed below will be used to evaluate Step-Two proposals. All proposals deemed to be compliant would be evaluated and categorized against these criteria. NASA plans to use site visits to collect additional information for the Step-Two evaluation. The six criteria cover:

- Scientific/Applications Merit
- Technical Implementation
- Management
- Cost Risk and Cost Realism
- Education
- Other Opportunity

The Scientific/Applications Merit criterion is nominally more important than any other factor. The Technical Implementation, Management, and Cost Risk and Cost Realism criteria are each nominally of equal importance, and combined outweigh the Scientific/Applications Merit criterion. The Education and Other Opportunity criteria are of equal value and are less important than the other criteria. The Science/Applications Merit, Education, and Other Opportunity criteria are measurements of quality and NASA will assign adjectival ratings as shown in Table 5.1-1. The Technical Implementation, Management, and Cost Risk and Cost Realism criteria are measures of implementation feasibility and NASA will assign risk ratings as shown in Table 5.1-2. Any criteria can outweigh all others if it jeopardizes overall mission success.

5.2.1 Step-Two Scientific/Applications Merit Criterion

NASA will use the following to evaluate the Science/Applications Criterion.

- The overall scientific and/or applications merit of the proposed investigation, as measured by
  - The scientific or applications objectives and justification of the proposed investigation relative to the research objectives and scientific questions described in section 2.0 and more generally to the NASA Earth Science research strategy in Appendix A.
  - The coherence of the traceability from the proposed objectives to the measurements required to the instrument functional requirements and the instrument/mission engineering requirements.
  - The scientific resilience of the investigation, as reflected by the assessment of the minimum science mission and the proposed descope options and the sensitivity to

and likelihood of reduced performance or shortened mission life if they become necessary.

- The relevance of the proposed investigation to NASA's Earth Science Enterprise research strategy, its science and application priorities, and the specific research objectives of this ESSP AO.
- The uniqueness and innovation of the proposed investigation. This will include the relationship between the proposed investigation and other approved Earth Science missions including NASA, other government, international, and commercial missions.
- The feasibility of the proposed investigation, including maturity of the underpinning research, the feasibility and risk of achieving objectives based on the proposed instrumentation and technical implementation, the risk that the investigation will not meet the objectives as proposed. Note: NASA will assess the capability of the proposed measurement to achieve the objectives under the Science/Applications criterion, and will assess the capability of the proposed instrument to achieve the proposed measurement under the Technical Implementation criterion.
- The ability of the proposed mission to resolve the proposed scientific/applications questions through a focused mission
- The expertise and experience of the senior members for the science and applications team in relation to the proposed science or applications objectives.
- The adequacy of the correlation measurements and validation activities.
- The adequacy of the data processing and distribution plan, including analysis, archiving, and dissemination of data and results.
- Adequacy of plans to minimize time between data collection and dissemination to the scientific/applications community.
- Compliance with the guidelines and requirements of the AO.
- Adequacy and likelihood of success of plans to resolve outstanding science or applications issues by the completion of the Mission Design Review (MDR). Proposal team's plans shall be described.

5.2.2 Step-Two Technical Implementation Criterion

NASA will use the following to evaluate the Technical Implementation criterion.

- Mission design, including adequacy, achievability, completeness, and traceability to high level objectives and constraints.
- Spacecraft hardware and flight software including reliability, risk, technical maturity, development schedule, performance margins, spacecraft maturity matrix.
- Instrumentation: Note: NASA will assess the capability of the proposed measurement to achieve the objectives under the science and applications criterion, and will assess the capability of the proposed instrument to achieve the proposed measurement under the technical implementation criterion.
- Instrument Interface and Payload Integration: including definition, clarity, and simplicity of interfaces and the consistency between the requirements and constraints of the spacecraft and the instrument.
- Launch vehicle: reliability, compliance with NASA and National policy

- Manufacturing, Integration, and Test; including schedule, facilities, test planning (Hardware, software, environmental, lifetime) or adequacy of design if testing not proposed, integration to the launch vehicle.
- Ground and data systems including adequacy and completeness of proposed approach, software development, data processing approach, testing, use of appropriate standards, and spectrum allocation requirements and approach.
- Mission Operations; including adequacy and completeness of approach, facility requirements (new or existing), security and redundancy.
- Compliance with the guidance and requirements of the AO.
- Approach to limiting Orbital Debris generation and other environmental impacts during design, planning, mission operation, and safe post-mission disposal.
- Adequacy and likelihood of success of plans to resolve outstanding technical implementation issues by the completion of formulation and/or by the MCR. Proposal team's plans shall be described.

5.2.3 Step-Two Management Criterion

NASA will use the following to evaluate the Management criterion.

- Management processes and plans, schedules and procurement strategy, including:
  - Extent and effectiveness of proactive practices
  - Decision making process
  - Internal reviews and control
  - External reviews, NASA audits and insight
  - Schedule and work flow
  - Procurement strategy, plan, major subcontracts, and agreements
  - System Engineering
  - Document Tree
  - Compliance with the Earth Explorers Program Mission Deliverables List in Appendix S
- Team organization and structure, including:
  - Clarity and appropriateness of proposed roles and responsibilities
  - Clarity of lines of authority
  - Commitment of key personnel, including principal investigator, project manager and systems engineer, and their institution.
  - Experience of key personnel
  - Documented Agreements and signatures for key mission elements
  - Plans for physical accommodations (co-location of team, etc.)
- Risk Management Plan, including insight and control of:
  - Mission risk identification, mitigation, tracking and resolution compliant with the Earth Explorers Program Continuous Risk Management Plan, available through the ESSP Project Library
  - Schedule margins (funded)
  - Performance margins
  - Budget reserves

  - Descope options (including decision dates and resource savings)
  - Identification of risks, and risk mitigation strategies
  - Linkage between level of risk and all margins and reserves as a function of schedule or mission development phase.
  - Cost management and tracking (expected vs. actual, etc.)
- Mission Assurance and Safety, including:
  - Compliance with the Mission Assurance Guidelines and Requirements in Appendix H
  - Compliance with the Flight and Ground Safety Requirements in Appendix J
  - Compatibility with ISO 9000 or industry best practices
  - Problem/failure reporting system
  - Inspection and quality control plans
  - System level verification (ground and/or space)
  - System safety assurance
  - Software validation
  - Parts selection and control
  - Reliability analysis and identification of failure modes and single point failures
  - Management of the cost of quality
- Facilities and Equipment, including:
  - Identification of major facilities and equipment required (both existing and new)
  - Commitment that major facilities and equipment will be available within schedule and budget
- Integrated assessment of overall mission complexity and implementation risk.
- Compliance with the guidance and requirements of the AO.
- Independent validation and verification of software as needed.
- Adequacy and likelihood of success of plans to resolve outstanding management implementation issues by the completion of the Mission Design Review (MDR). Proposal team's plans shall be described.

5.2.4 Step-Two Cost Risk and Cost Realism Criterion

NASA will use the following to evaluate the Cost Risk and Cost Realism criterion.

- Cost Realism and validity, including:
  - Basis, heritage and quality of proposal cost estimates, particularly for the spacecraft (if appropriate) and instruments(s) by subsystem, and the proposed ground data handling system(s)
  - Realism of the proposed budget
  - Clarity and completeness of the proposed work breakdown structure (WBS)
  - Cost estimating methodology
- Cost Risk including:
  - Adequacy of proposed cost and schedule reserves
  - Understanding of required resources and risks demonstrated in proposal

  - Linkage between technical and schedule risks, reserves (performance, budget, and schedule), and descope options
  - Past cost performance of major partners (if appropriate)
- Compliance with the guidance and requirements of the AO.
- Adequacy and likelihood of success of plans to resolve outstanding cost and cost related issues by the completion of the Mission Design Review (MDR). Proposal team's plans shall be described.
- Adequacy of reserves consistent with the level of complexity associated with different components of the proposed mission.

5.2.5 Step-Two Education Criterion

The general evaluation criteria used for all NASA Research Announcements (NRA's) are applicable here; the principle elements are the proposal's relevance to NASA's objectives, its intrinsic merit, and its cost.

- Evaluation of the Education Plan's relevance to NASA's objectives includes consideration of:
  - the potential contribution of the effort to the *NASA Educational Excellence* (http://education.nasa.gov)
  - the degree to which the effort contributes to the Earth Science Enterprise 10 year educational goals described in the Earth Science Enterprise Strategic Plan (November 2000; see page 26).
- Evaluation of intrinsic merit includes consideration of the following factors listed in order of decreasing importance:
  - Overall educational or technical merit of the Education Plan and/or particularly effective or innovative methods, approaches, concepts, or advanced technologies demonstrated by the proposal
    - merit of the identified educational need
    - quality of project design; evidence of a genuine, good idea and thoroughness in implementation
    - robustness of the evaluation plan
    - alignment with national agenda in science, mathematics, engineering, technology and geography education
    - engagement of underrepresented groups in science and technology
    - scalability, sustainability beyond NASA investment, partnerships, and "multiplier" effect
    - when appropriate, synergy among formal, informal, and professional educational activities
  - Offeror's capabilities, related experience, facilities, techniques, or unique combinations of these which are integral factors for achieving the proposed objectives
  - The qualifications, capabilities, and experience of the proposed Education team leader and members, or key personnel critical in achieving the proposed objectives
  - Overall standing among similar proposals and/or evaluation against the state-of-the-art or acknowledged "best practices"

- Evaluation of cost of the proposed effort shall include consideration of the realism and reasonableness of the proposed cost and the comparison in relation to impact.

5.2.6 Step-Two Other Opportunity Criterion

NASA will use the following to evaluate the Other Opportunity criterion.

- Plans for significant participation in the mission team by:
  - Historically black colleges and universities (HBCUs) and other minority universities (OMUs)
  - Small disadvantaged business concerns in the authorized North American Standard Industrial Classification (SIC) Groups as determined by the Department of Commerce (see FAR 19.201(b))
  - Small businesses
  - Women-owned small businesses
  - Veterans-owned small businesses
- Commercial opportunities:
  - Identification and consideration of commercialization opportunities
  - Realism and viability of commercialization plans

5.3 Evaluation and Selection Process

Proposals received in response to this AO will be reviewed and selected in accordance with the procedures stated in NASA FAR Supplement 1872.4 as modified by this section. All non-U.S. proposals will go through the same evaluation, selection, and approval process as proposals originating in the U.S. Evaluation panels, using scientific/applications, technical, educational, management and administrative peers and experts, will assess the strengths and weaknesses of each proposal and will provide the NASA Headquarters Office of Earth Science with a summary report.

5.3.1 Step-One Process

The Step-One Proposals received will be peer reviewed by a scientific/applications and mission peer panel and evaluated according to the evaluation criteria in Section 5.1. Evaluation of the Step-One Proposal is intended to assess the in-depth scientific/applications merits, justification and maturity of the proposed mission in relation to the science/applications priorities (identified in Section 2.0), goals and objectives of the ESSP Project in support of the overall Earth Science Enterprise. Each proposer will be provided with an early determination of the scientific/applications and technical merit of the proposed investigation and instrumentation, along with a high-level risk assessment of the mission implementation approach. Based on this evaluation, each proposal will be assigned an adjectival science rating and a risk assessment (see Tables 5.1-1 and 5.1-2). Based on these ratings, which include feasibility of the proposed instrumentation, NASA will select the missions to be recommended to proceed to Step-Two, and notify each proposer accordingly. NASA intends to recommend only a limited number of highly rated investigations for continuation to Step-Two, and reserves the right to recommend lower rated missions if, based upon the information provided, they are expected to be significantly below the ESE Mission Cost ceiling.

5.3.2 Step-Two Process

Those proposers choosing to continue with the AO process will then be required to submit a Step-Two Proposal. NASA will consider only those proposals whose science objectives and methodologies have been evaluated in Step-One. Any proposal whose objectives or methodologies have not been evaluated, including proposals whose objectives or methodologies have changed from Step-One, will not be considered in Step-Two. Scientific/applications experts will assess the scientific/applications aspects of each compliant Step-Two Proposal, as well as look for changes since Step-one, in accordance with the evaluation criteria in Section 5.2. Concurrently, management, cost and technical experts shall also evaluate the implementation aspects (management, cost, and technical) of each proposal. In addition, appropriate experts will evaluate the education and other opportunities aspects of each proposal. After the individual evaluations, the panels will meet to consider the total quantitative and qualitative aspects of the evaluations in order to integrate the findings of the individual reviewers. The evaluation panels may also prepare questions requesting clarification, which will be transmitted to the appropriate proposers for prompt response. After these evaluations, the panels will meet in plenary in order to integrate the separate panel results and prepare the panel's individual comments that the PI's must address during site visits. Once the site visits are complete, the panels will reconvene to prepare the final evaluation report. Panel evaluation reports will represent the final product of the evaluation teams. In the event that NASA decides not to conduct site visits (e.g., if the number of Step-Two proposals received and the available evaluation funding does not allow full and complete site visits for all compliant offerors), NASA will conduct the evaluation based upon the proposal as submitted without site visits.

The ESSP Evaluation Executive Committee, consisting of the Evaluation Chairperson and the chairs of the individual evaluation panels will, upon consideration of the reports of the evaluation panels, integrate the Step-One and Step-Two results, which include the science return and technical, management, and cost evaluations, and provide an assessment of science value. The committee will then categorize all proposals in accordance with the category definitions contained in NASA FAR Supplement 1872.4 and provide its recommendation to the Associate Administrator for Earth Science. Based on these categorizations the Associate Administrator will select the proposals to be supported as investigations for formulation. Contract award for formulation will be dependent on approval of the various implementation documents (e.g., Mission Definition and Requirements Agreement, Statements of Work, etc.) and other required contract documents.

NOTICE TO ALL OFFERORS: In the event that a Principal Investigator employed by NASA is selected under this Announcement of Opportunity (AO), NASA will award prime contracts to non-Government participants, including co-investigators, hardware fabricators, and service providers, who are named members of the proposing team, as long as the selecting official specifically designates the participant(s) in the selection decision. Each NASA contract with hardware fabrications and service providers selected in this manner will be supported by an appropriate justification for other than full and open competition, as necessary.

Certain key provisions concerning selections are also given in Appendix I.

5.4 Contract Administration and Funding

Different mission management approaches and organizational arrangements may require different contract administration and funding arrangements. The PI is expected to recommend, as part of the teaming arrangement, the organizations and contract mechanisms NASA should consider in awarding work to the team. Participation by international partners will be on a no-exchange-of-NASA-funds basis. Therefore, any non-U.S. PI shall arrange with an U.S. co-investigator to fund U.S. participants under the proposal. NASA will directly fund or transfer funds to participating NASA Centers or other US Government Agencies based on the PI's recommendation.

For missions selected as a result of this AO, the proposed cost to complete the efforts leading to the Mission Design Review, as well as the ESE Mission Cost cap, will be considered to be fixed and committed to at the Step-Two selection. The ability of the PI to meet the proposed ESE Mission Cost cap will be re-evaluated at the MDR and during the MCR process. A post-selection survey may be conducted by the ESSP Project Office to ensure that commitments of equipment, technical resources, facilities, and letters of agreement between affiliated mission team members reflect the written proposal, the Mission Definition and Requirements Agreement, Statements of Work, and other proposed contract documents.

In order to expedite contract award after selection, all proposed contractual documentation, if accepted by NASA, will be considered executable upon selection. However, NASA reserves the right to negotiate all contract terms and conditions following the mission selection.

6.0 CONCLUSION

The ESSP Project represents a challenging and innovative approach for NASA to accomplish important scientific investigation of the Earth system. It provides an opportunity for frequent flights to execute science investigations at the forefront of Earth System Science to secure answers to key and strategically important Earth Science questions through a variety of partnership arrangements and investment opportunities. Given the limited experience base in this area, NASA is prepared to assist prospective proposers in identifying technical and management partners to assure the team's success. NASA invites both the U.S. and international science communities to participate in proposals for ESSP missions to be carried out as a result of this Announcement.

We envision that the ESSP Missions, together with other Earth Observing Satellites that are being developed by NASA and its domestic and international partners, will provide unprecedented observational capabilities for examining practically all aspects of the Earth System from space in the early part of this century. The geospatial information resulting from these observations, coupled with the revolutionary computational and telecommunications technologies, are the essential means by which the Earth science and applications communities can explore how the Earth system is changing and assess the consequences for life on Earth. The societal benefits of this national and international investment are improved and extended short-term weather forecasts, climate prediction, and assessment and prediction of natural hazards.

The NASA Earth Science Enterprise is proud to have the privilege of pushing the frontiers of scientific discoveries and exploration of our home planet, Earth, to secure the necessary scientific knowledge for establishing sound policy decisions and accommodating the application of this knowledge towards solving practical societal problems in food/fiber production, management of natural resources, and establishing roads and infrastructure.

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Dr. Ghassem R. Asrar
Associate Administrator
Office of Earth Science
NASA Headquarters

APPENDIX A

NASA EARTH SCIENCE RESEARCH STRATEGY FOR 2000-2010

This Appendix will contain the Executive Summary from "Understanding Earth System Change, NASA's Earth Science Enterprise Research Strategy for 2000-2010." The complete research strategy will be available early January 2001 through the Earth Science Enterprise's Strategic Visions web page. The uniform resource locator for this Strategic Visions page is:

http://www.earth.nasa.gov/visions/index.html

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APPENDIX B

CONTENTS OF THE ESSP AO-3 LIBRARY

The ESSP Project Library includes documents available from a number of Internet web sites as well as paper copies. Where the same document is available as paper copy and electronically, proposers are requested to access the document electronically unless Internet access is unavailable. Only limited paper copies of documents will be available. Note that not all documents are available in the ESSP Project Library, but access information is provided.

The ESSP AO-3 Library is accessible on the World Wide Web at the URL address:
http://essp.larc.nasa.gov/essp

NASA AGENCY REFERENCES:

1. NASA Strategic Plan
2. NASA Technology Portal
3. NASA Technology Plan

EARTH SCIENCE REFERENCES:

NASA

4. NASA Earth Science Enterprise Website
5. Earth Science Strategic Enterprise Plan 1998-2002
6. Mission to Planet Earth/Earth Observing System Reference Handbook
7. Science Plan for Earth Observing System
8. Report of the Workshop on NASA Earth Science Enterprise Post-2002 Missions
9. Land Cover Land Use Change Program
10. MTPE Commercial Strategy
11. In Situ Observations for the Global Observing Systems
12. Earth Science Integrated Technology Strategy (Currently under review.)
13. NASA Earth Science Enterprise Statement on Data Management

EXTERNAL

14. National Academy of Sciences (1995) A Review of the U.S. Global Change Research Program and NASA's Mission to Planet Earth/Earth Observing System
15. Committee on Environment and National Resources (CENR) Research of the National Science and Technology Council (1996) Our Changing Planet the FY 98 U.S. Global Change Research Program, A Supplement to the President's Fiscal Year 1998 Budget

TECHNICAL:

SYSTEMS ENGINEERING

16. NASA Program and Project Management Processes and Requirements (NPG 7120.5A)

COMMUNICATION

17. CCSDS Standards

ENVIRONMENTAL TEST REQUIREMENTS

18. General Environmental Verification Specification for STS & ELV Payloads, Subsystems and Components

EDUCATION:

19. ESE Education Strategy - March 1996
20. NASA Implementation Plan for Education 1999 to 2003

LAUNCH SERVICES:

EXPENDABLE LAUNCH VEHICLES (ELVs)

21. Launch Services Risk Mitigation Policy for NASA-Owned Or NASA-Sponsored Payloads
22. Expendable Launch Services for ESSP-3 Announcement of Opportunity

SHUTTLE

23. ESSP Space Shuttle Launch Opportunities
24. Shuttle Small Payloads Project Office
25. Spartan Project
26. Space Shuttle Future Flights
27. SMEX Safety, Reliability, and Quality Assurance Requirements. Describes the responsibilities of the PI with regard to Safety, Reliability, and Quality Assurance.
    - NSTS System Safety Milestones and Process Flow. For those PI's intending to use the Space Shuttle, a reference for the development of their system safety plans and associated cost estimates.
    - ELV System Safety Milestones and Process Flow. For those PI's intending to utilize Expendable Launch Vehicles, a reference for the development of their system safety plans and associated cost estimates.

INTERNATIONAL SPACE STATION

28. International Space Station ESSP Research Opportunities
29. SSP57000, Rev. C - Pressurized Payloads Interface Requirements Document
30. SSP52000-IDD-EPP, IDD EXPRESS Pallet
    - SSP52000_IDD_EPP_main.pdf
    - SSP52000_IDD_EPP_app.pdf
    - SSP52000_IDD_EPP_errata.pdf
31. SSP57003, Interface Control Document for Attached Payloads
32. SSP50404, Window Observational Research Facility Block I Project Requirements Document

FEDERAL ACQUISITION REGULATIONS (FAR) ELECTRONIC DOCUMENTS:

33. Federal Acquisitions Regulations (FAR) GENERAL SERVICES ADMINISTRATION
34. NASA FAR Supplement Regulations
35. NASA Financial Management Manual

GENERAL REFERENCE INFORMATION:

36. EOSDIS Information
37. NASA's Mission Operations and Communication Services (SOMO) Generic Contract Terms and Conditions for ESSP Missions (Educational Institution)
38. Generic Contract Terms and Conditions for ESSP Missions (Commercial Organizations)
39. Earth Science Systems Program Library (MTPE Library) (Information ONLY, no documents are available from this site)
40. Mission Definition and Requirements Agreement - Example
41. Elements to be Included in Arrangements between U.S. Principal Investigators and Cooperating Foreign Parties Under the ESSP Program
42. ESSP Mission Confirmation Plan
43. Examples of Education and Public Outreach Activities
44. U.S. Accredited Post Secondary Minority Institutions
45. Basics of Space Flight
46. Access to Space

RELIABILITY AND QUALITY ASSURANCE, MATERIALS AND EEE PARTS:

47. NASA/GSFC Office of Systems Safety and Mission Assurance
48. NASA Technical Standards
    - NASA Technical Standard NASA-STD-8739.3, Soldered Electrical Connections
    - NASA Technical Standard NASA-STD-8739.4, Crimping, Interconnecting Cables, Harnesses, and Wiring
    - STD-8739.1, Workmanship Standard for Staking and Conformal Coating of Printing Wiring Boards and Electronic Assemblies
    - NASA Technical Standard NASA-STD-8739.7, Electrostatic Discharge Control (Excluding Electrically Initiated Explosive Devices)
    - NASA Technical Standard NASA-STD-8739.5, Fiber Optic Terminations, Cable Assemblies, and Installation
    - STD9739.2, Workmanship Standard for Surface Mount Technology
    - ANSI/IPC-D-275 Design Standard for Rigid Printed Boards and Rigid Printed Board Assemblies, Class 3 (Not Currently Available Electronically)
    - IPC 6011 and IPC 6012, Class 3 as the basic specification requirements with GSFC S-312-P-003B, Procurement Specification for Rigid Printed Wiring Boards for Space Applications and other High Reliability Uses as a supplement (Not Currently Available Electronically)
49. Earth Explorers Mission Assurance (Document is under development)

SAFETY:

50. NASA Office of Safety & Mission Assurance
51. Risk Management
52. Software IV & V
53. NSTS 1700.7B, "Safety Policy and Requirements for Payloads Using the Space Transportation System"
54. 45 SPW S-100/KHB 1700.7B, "Space Shuttle Payload Ground Safety Handbook" (Document does not include Appendices)
55. EWR 127-1, "Eastern and Western Range Safety Requirements"
56. NPD 8710.3 NASA Policy For Limiting Orbital Debris Generation
57. NSS 1740.14 Guidelines and Assessment Procedures for Limiting Orbital Debris
58. RSM-93, "Range Safety Manual for Goddard Space Flight Center (GSFC)/Wallops Flight Facility (WFF)"
59. "Range Safety Project Support Process"
60. "Flight Safety Process"
61. "Ground Safety Process"
62. (SSD TD-0005) (currently Rev B), "Pegasus Design Safety Requirements Document" (Not Currently Available Electronically)
63. SSD TD-0018) (currently Rev A), "Pegasus Safety Requirements Document for Ground Operations" (Not Currently Available Electronically)
64. Earth Explorers Safety Requirements

OTHER NASA SERVICES:

65. NASA Space Operations Mission Office (SOMO)
66. Rapid Spacecraft Development Office (RSDO)

ISO 9000 Series:

The following ISO 9000 quality documents describe current national and NASA standards of quality processes and procedures.

Note: The first three ISO 9000-related documents are copyrighted and cannot be reproduced without appropriate compensation. For copies contact:

American Society for Quality Control (ASQC)
P.O. Box 3066
Milwaukee, WI 53201-3066
1-800-248-1946

67. American National Standard, "Quality Systems - Model for Quality Assurance in Design, Development, Production, Installation, and Servicing", ANSI/ASQC Q9001-1994.
68. "Quality Management and Quality System Elements - Guidelines", ANSI/ASQC Q9004-1-1994.
69. "Quality Management and Quality Assurance Standards - Guidelines for Selection and Use", ANSI/ASQC Q9000-1-1994.
70. "NPD 8730.3 NASA Quality Management System Policy (ISO 9000)"

APPENDIX C
LAUNCH SERVICES COST TABLE

This information can be found in the ESSP-3 AO Library "Expendable Launch Services for ESSP-3 Announcement of Opportunity" at the following URL.

http://essp.larc.nasa.gov/essp

The one-half, shared Delta launch vehicle will be included as a launch option for this AO. Information concerning the Delta vehicle will be included in the "Expendable Launch Services for ESSP-3 Announcement of Opportunity" document as soon as it is available.

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APPENDIX D

MISSION CONFIRMATION REVIEW PROCESS

Note: This Appendix to the ESSP AO describes the general Mission Confirmation Review Process for Earth Explorers at the NASA Goddard Space Flight Center, and is representative of the process at other NASA Centers. NASA headquarters will determine which NASA Center will monitor your mission implementation at the time of mission selection.

The Mission Confirmation Review Process is a NASA Center led effort to provide an independent assessment of mission readiness to proceed to implementation. The level of Center involvement in any particular mission selected through this AO can vary. To avoid even the perception of any conflict of interest, a NASA headquarters led team will independently assess the results of the Mission Formulation and Mission Confirmation Review Process at the completion of the Mission Design Review (MDR). The PI, Project/Mission Manager, the MDR co-chairs, and the NASA Center program office will present the findings and recommendations from the MDR and the Mission team responses, to the NASA headquarters team before presenting these to the Governing (NASA Center) Program Management Council (PMC). NASA headquarters will determine which missions will complete the Mission Confirmation Review.

Preface

A formal Confirmation Review process is required for all Earth Explorers Program missions. These missions are either directed by the Earth Science Enterprise based on national priorities or, solicited and selected through an Announcement of Opportunity (AO) such as Earth System Science Pathfinder (ESSP) or the University Earth System Science (UnESS). The purpose of this process is to establish that the project team has completed a credible and acceptable mission formulation subprocess and is prepared to proceed with the implementation subprocess to complete the flight and ground system development and mission operations within the identified cost and schedule constraints for the mission.

A Mission Design Review (MDR) is typically held toward the end of the definition phase of the formulation subprocess, but prior to the initiation of full-scale flight hardware/software development. The MDR Panel will be co-chaired by an independent expert (appointed by the GSFC Earth Explorers Program Office), and typically a technical co-chair from the GSFC System Review Office (SRO). The Earth Explorers Program Office and the co-chairs will select review panel members to assess the maturity of the mission, program status and ability to meet program commitments. The findings from the MDR are then presented to the GSFC Governing Program Management Council (GPMC) at a Confirmation Readiness Review (CRR) for consideration resulting in recommendations on mission confirmation. These recommendations are presented to the Associate Administrator (AA), Office of Earth Science (OES), who has final approval authority on mission confirmation. Approval of mission confirmation constitutes direction to begin the mission implementation subprocess.

1.0 Introduction

1.1 Objective

The objective of the Earth Explorers Program Office Mission Confirmation process is to provide the Earth Explorers Program Office, the GPMC and the Office of Earth Science with an independent assessment of mission readiness to proceed with the Implementation Subprocess, by identifying the technical, financial, and management risks associated with mission development and operations, and suggesting action to reduce or mitigate the risks. The products of this process will be:

- A presentation of the findings of the MDR given to the Earth Explorers Program Manager, the mission Project Manager and the Principal Investigator (PI) for feedback and resolution of outstanding actions. The criteria for this review are defined in this plan.

- A formal presentation of the findings of the MDR, and project responses to the findings, to the GPMC at a Confirmation Readiness Review (CRR). Based on the MDR findings and project responses the GPMC will develop recommendations on mission confirmation to be presented to the AA, OES.

1.2 Scope

The Earth Explorers Mission Confirmation process will assess the complete life cycle of the mission. Areas that will undergo review include but are not limited to system designs (hardware and software), deliverable science data products, launch vehicle interface, and mission operations, and the overall technical readiness of the mission. Management, design, manufacturing, product assurance, test plans and test facilities are also included in the scope of the assessment. In summary, the review will focus on the mission's ability to meet technical, cost and schedule commitments.

1.3 Ground Rules

a) The Mission Design Review Panel will consist of experts from appropriate disciplines who are independent of the mission being reviewed.

b) The Mission Design Review Panel deliberations may be conducted in closed session at the discretion of the Chairperson.

c) The mission requirements are defined in the Mission Level 1 Requirements Document. The panel will assess the mission based on the ability to deliver the science data as defined in the above document.

2.0 Mission Design Review

2.1 Mission Design Review Organization

The MDR panel is led by the Co-Chairs, who will coordinate with the Project/Mission Manager to ensure that the team has access to sufficient information to accomplish its objectives with a minimum impact to the mission. They will coordinate the review panel activities and present the findings. The team members are selected by the Co-Chairs and are approved by the Earth Explorers Program Office.

2.2 Review Process

The Mission Design Review typically will be held over a 2-3 day period at GSFC or a suitable mission team site. The panel will meet at the conclusion of each day to discuss the results of the day's presentations and develop the preliminary findings and recommendations. At these sessions, panel members should be prepared to brief the MDR Co-Chairs on their findings for their assigned area. The individual briefings will then be integrated into comprehensive findings of the panel. At the conclusion of the review, each member will provide the Co-Chairs with a summary of their findings, as well as any specific action items or recommendations they have identified. The Co-Chairs will brief the Principal Investigator, Project/Mission Manager and the Earth Explorers Program Manager on the review panel findings at this time. The PI, project manager and their mission team will develop responses to the panel findings, which will be coordinated with the MDR Co-Chairs. The Principal Investigator, Project/Mission Manager, the MDR Co-Chairs and the Earth Explorers Program Office will then present the findings, recommendations and responses to the Goddard Program Management Council at the CRR for recommendations for proceeding into the mission implementation subprocess. The GPMC will present their recommendation to the Office of Earth Science Associate Administrator for approval. In order to minimize the impact on the mission schedule, the entire confirmation process should be completed within two months.

2.3 Nominal Schedule

Mission Design Review	Duration of 2-3 days
Panel members' report due to Chairperson	At conclusion of MDR
Panel brief to PI/Project/Earth Explorers	At conclusion of MDR
PI/Project Team Response	Within 3 weeks after MDR
GPMC Confirmation Readiness Review	Within 4 weeks after MDR
ESE Mission Confirmation Review	Within 2 weeks after CRR

3.0 Success Criteria

3.1 Science and Technical Evaluation

1. Does the Mission, Spacecraft and Instrument Design, as presented, reflect a level of maturity that meets the mission science requirements?

Scope of Criteria 1 - Indicator questions

What are the mission science requirements? How have requirements been allocated to each mission element, e.g., spacecraft, instrument, and ground system? What is the status of requirement allocations to subsystems of each element?

What is the status of the hardware being developed for the mission? What has affected the hardware development since mission selection? What critical activities (design, tests, etc.) remain to assure the hardware can be included in the mission?

What are the technical metrics used by the project? What is the status and trend of each?

What are the results of analyses, tests and design activities related to the hardware developments?

What system trades have been completed? What are the remaining trade studies that must be completed?

What is the specific design and/or flight heritage of the spacecraft systems and instruments?

What is the status of the primary interfaces, e.g., instrument to spacecraft, spacecraft to launch vehicle, and spacecraft to ground? What design, test, and integration tasks are allocated to NASA, or other government agencies?

What is the status of the software development? How has software been estimated for each element and subsystem? How have margins been allocated to accommodate any technologies affecting the software?

What validation/calibration is needed/planned prior to launch to ensure science objectives are met? What is the science validation plan during operations? What critical data are needed during operations and how are the data to be captured?

What is the descope plan and what are the milestones for descope? What are potential mass, power, and software impacts for each descope option? Has the project quantified the potential impacts?

What are the cost and schedule impacts/improvements for each descope option? What is the impact of each descope option on the mission science deliverables?

What is the test and integration plan for the project?

What is the mission operations concept?

What is the ground system architecture?

3.2 Management Structure and Composition Evaluation

2. Are the Management Processes used by the Mission Team sufficient to develop and operate the Mission?

Scope of Criteria 2 - Indicator questions

What is the systems engineering management approach?

Are the roles and responsibilities of each organization clearly defined? What is the experience of key project personnel in each organization? What processes are in place for making, communicating and implementing project decisions? What project management system, in place or planned, is used to track the status of each task and its deliverables?

Is there a common cost/schedule reporting system being utilized across the project?

What is the risk identification and mitigation process? What risks have been identified? What are the mitigation plans?

What is the process for managing and implementing mission descopes? Who has approval authority for implementing descopes?

What is the critical path and how is it being routinely assessed and managed?

Is the WBS complete with all deliverables defined? Is there an intersite delivery plan or matrix?

What is the plan for manufacturing the spacecraft and instruments? What are the critical long lead parts or material? What is the long lead procurement status? Have all required facilities been identified and utilization planning developed? Are agreements in place for use of facilities for testing? What is the schedule flexibility?

What oversight/insight is the program office exercising on all elements? How and to what tasks have program office civil servant resources been allocated to supplement developments?

What process changes are being made to minimize the development time and cost (smaller, faster, cheaper)?

3.3 Cost and Schedule Evaluation

3. Do the cost estimates, control processes and schedules indicate the mission will be ready to launch on time and within budget?

Scope of Criteria 3 - Indicator questions

What is included in the project budget and what is covered elsewhere?

For items covered outside the project budget, is there sufficient funding planned? Could the project cover shortfalls for these items with project budget?

How does the current cost estimate and burn-rate compare to the baseline? Does the cost analysis indicate the mission will stay within the project budget?

What cost and schedule monitoring and control processes are in place? How is progress being measured? How are reserves allocated and released? Is there sufficient reserve in cost and schedule to complete the mission by the planned launch date?

What incentives are in place to control cost and schedule? How are the program cost caps reflected in contracts and allocated?

APPENDIX E

REGULATIONS GOVERNING PROCUREMENT OF FOREIGN GOODS OR SERVICES

The following Federal Acquisition Regulation (FAR) clauses apply to the purchase of foreign goods and services and may be included in contracts resulting from this Announcement of Opportunity:

FAR 52.225-1	Buy American Certificate (Dec 1989)
FAR 52.225-3	Buy American Act -- Supplies (Jan 1994)
FAR 52.225-7	Balance of Payments Program (Apr 1984)
FAR 52.225-8	Buy American Act -- Trade Agreements -- Balance of Payments Program Certificate (Jan 1994)
FAR 52.225-9	Buy American Act -- Trade Agreements -- Balance of Payments Program (Jan 1994)
FAR 52.225-10	Duty-Free Entry (Apr 1984)
FAR 52.225-11	Restrictions on Certain Foreign Purchases (Aug 1998)
FAR 52.225-18	European Union Sanction for End Products (Jan 1996)
FAR 52.225-19	European Union Sanction for Services (Jan 1996)
FAR 52.225-21	Buy American Act -- North American Free Trade Agreement Implementation Act -- Balance of Payments Program (Jan 1997)

The Proposer is directed to the Federal Acquisition Regulation for further information on these regulations.

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APPENDIX F

ELEMENTS TO BE INCLUDED IN ARRANGEMENTS BETWEEN U.S. PROPOSAL TEAM LEADERS AND COOPERATING FOREIGN PARTIES

The following elements shall be included in arrangements between the proposing team leader and foreign Parties contributing to or cooperating in activities under the Earth Exploratory Mission Announcement of Opportunity.

SCIENCE DATA RIGHTS

Unless otherwise agreed between NASA and the selected Earth Exploratory Mission Proposal Principal Investigator, all science data resulting from this cooperative activity will be made available to all users without restriction at no more than the cost of dissemination, through appropriate data archives in the United States and [foreign country]. In the event that reports or publications based upon this data are copyrighted, the Parties and NASA shall have a right under the copyright to reproduce, prepare derivative works from, perform, display, and distribute copies of such copyrighted work for their own purposes royalty-free. If data resulting from missions have commercial value, data information rights and policies must be negotiated with NASA on a case-by-case basis.

EXCHANGE OF TECHNICAL DATA AND GOODS

The Parties are obligated to transfer only those technical data (including software) and goods necessary to fulfill their respective responsibilities under this agreement, in accordance with the following provisions:

1. The transfer of technical data for the purpose of discharging the Parties' responsibilities with regard to interface, integration, and safety shall normally be made without restriction, except as required by national laws and regulations relating to export control or the control of classified data. If design, manufacturing, and processing data and associated software, which is proprietary but not export controlled, is necessary for interface, integration, or safety purposes, the transfer shall be made and the data and associated software shall be appropriately marked. Nothing in this article requires the Parties to transfer goods or technical data contrary to national laws and regulations relating to export control or control of classified data.

2. All transfers of proprietary technical data and export-controlled goods and technical data are subject to the following provisions. In the event a Party finds it necessary to transfer goods which are subject to export control or technical data which is proprietary or subject to export controls, and for which protection is to be maintained, such goods shall be specifically identified and such technical data shall be marked with a notice to indicate that they shall be used and disclosed by the receiving Party and its related entities (e.g., contractors and subcontractors) only for the purposes of fulfilling the receiving Party's responsibilities under the programs implemented by this Agreement, and that the identified goods and marked technical data shall not be disclosed or retransferred to any other entity without the prior written permission of the furnishing Party. The receiving Party agrees to abide by the terms of the notice, and to protect any such identified goods and marked technical data from unauthorized use and disclosure, and also agrees to obtain these same obligations from its related entities prior to the transfer.

3. All goods, marked proprietary data, and marked or unmarked technical data subject to export control, which are transferred under this Agreement, shall be used by the receiving Party exclusively for the purposes of the programs implemented by this Agreement.

LIABILITY

If the successful proposing team has elements of foreign cooperative activity, a cross-waiver of liability may be required at the appropriate time.

APPENDIX G

EARTH SCIENCE ENTERPRISE
DATA AND INFORMATION SYSTEMS AND SERVICES
INTERFACES AND STANDARDS

NASA ESE Data Policy

NASA ESE requires PIs to adhere to a principle of full and open access to ESE data products; that is, NASA is committed to the full and open sharing of Earth Science data obtained from U.S. Government-funded and -owned systems with all users as soon as such data become available, except as discussed in Section 3.2.3. ESSP PIs selected as a result of this AO are required to make their level 1 and higher-level data products available to the general public in a timely manner. The ESE Data Policy is available at http://www.earth.nasa.gov/visions/data-policy.html.

Earth Science Enterprise Required Interfaces

ESSP PIs are required to publicize their products and data services to the broader Earth Science community via the Global Change Master Directory (GCMD). PIs will ensure population of the GCMD with appropriate information on their instrument and data products and services, and provide pointers to their World Wide Web (WWW) page or other client interface for search and access. All data set descriptions shall be provided as Directory Interchange Format (DIF) entries, which are automatically compliant with the Federal Geographic Data Committee (FGDC) standard for geospatial data. The content for DIFs can be easily submitted through the DIFbuilder tool, available at http://gcmd.nasa.gov/difbuilder. Descriptions for related data tools or services shall be provided as Services Entry Record File (SERF) entries, for which the content can be submitted through the SERF builder tool, available at http://gcmd.nasa.gov/serfbuilder. Contact the GCMD User Support Office at http://gcmd.nasa.gov/ for assistance.

Data Archival and Access

Adequate funds shall be included in the proposal for all data set development activities, including production, management, distribution, complete documentation of the data set and supporting peer-reviewed articles, and to ensure the smooth transition to final archival disposition.

The proposal shall describe the science information system that will provide the active archive during the ESSP mission phase, including a complete description of the products and the methodology for their full and open provision.

For data archive and distribution, ESSP PIs may decide to partner with one of the NASA Data Centers in the Distributed Active Archival Center (DAAC) Alliance, or a designated Long Term

Archive (LTA) site at NOAA or USGS, as appropriate. The DAAC Alliance Data Centers are described in the web site at: http://nasadaacs.eos.nasa.gov/.

NASA presently works with a Federation of Earth Science Information Partners (ESIPs), which includes the DAACs. ESSP PIs are encouraged to investigate the ESIP Federation if an alternate arrangement than provision of data through a DAAC Alliance data center is envisioned. More information on the ESIP Federation can be found at http://www.esipfed.org/.

ESSP PIs are required to archive their basic data (typically Level 1 data) at one of the NASA DAAC Alliance data centers or at an LTA site. If the PI plans for an alternate arrangement for mission phase data archive and dissemination, the proposer shall make, and include in the proposal, a transition agreement with an appropriate DAAC Alliance or LTA center to ensure the smooth transition to post-mission archival disposition. Each data set shall be accompanied with clear, comprehensive, and concise documentation so that specialists and non-specialists alike will be able to understand how the data can be used.

Data and Metadata Standards

To facilitate access to ESSP data by the Earth Science community, it is recommended that ESSP missions produce data products in a core NASA-provided or community-endorsed format compatible with the research community that will utilize the data, and that the missions generate and store metadata describing their data products that will facilitate user search and order, and user understanding of product quality and utility.

The present EOS missions standards being utilized at four DAACs are the HDF-EOS (hierarchical data format) standard data format and metadata that conforms to the intermediate level of the EOSDIS Core System (ECS) Metadata Standard. Information on HDF-EOS and the ECS Metadata Standard is provided below. The proposed partner DAAC can also provide appropriate DAAC-unique NASA-provided standards and interfaces. If a PI proposes to use other methods or standards for data product and metadata, then the approach and rationale shall be provided. All such costs for data production, management and distribution, including DAAC costs, shall be included in the cost proposal.

The HDF-EOS Primer, HDF-EOS Specification, and HDF-EOS Application Program Interfaces may be located via the WWW at http://hdfeos.gsfc.nasa.gov/hdfeos/workshop.html. Software for producing HDF-EOS data, serving HDF-EOS data on the WWW, and visualizing HDF-EOS data is also referenced at this Web page.

Adherence to the intermediate level of the ECS Metadata standard will result in the creation of directory, inventory and guide level information compatible with EOSDIS Version 0 data standards and facilitate future interoperability with EOSDIS Version 0 and ECS-based versions. The ECS “Release 6A Implementation Earth Science Data Model 420-TP-022-001” may be located via the WWW at http://edhs1.gsfc.nasa.gov/.

ESIP Federation members support a multi-faceted System Wide Interface Layer (SWIL) which conforms to DAAC Alliance Standards. A primary component of the SWIL is the GCMD, to

which all ESIP PIs submit DIFs and SERFs as described above. Many ESIPs also support the EOSDIS V0 Information Management System with data inventory information for search and order functionality. Another important component of the SWIL is the Mercury search system. Using WWW documents and protocols, Mercury combines DIFs, web pages and other documents, optional data inventory listings, and optional service listings in a single catalog organized by data set. Federation members are also exploring data access interoperability through emerging community systems.

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APPENDIX H

MISSION ASSURANCE GUIDELINES AND REQUIREMENTS

Note: This Appendix to the ESSP AO describes the general Mission Assurance Guidelines and Requirements for Earth Explorers at the NASA Goddard Space Flight Center, and is representative of the guidelines and requirements at other NASA Centers. NASA headquarters will determine which NASA Center will monitor your mission implementation at the time of mission selection.

PREFACE

The purpose of this document is to serve as a set of requirements and guidelines to the Project/Mission Team in preparing an appropriate mission assurance program and its implementation. Each section of this document contains requirements and a series of guidelines for implementing mission assurance in accordance with the Earth Explorers Program. The guidelines may be tailored to meet the specific needs of each mission, but this tailoring shall be reviewed and accepted by the Earth Explorers Program Office and must meet the intent of the requirements. Each Earth Explorers project/mission is required to be implemented in accordance with the aerospace industry best practices for mission assurance, as they apply to that particular mission.

1.0 Overview

It is the responsibility of the Project/Mission Team to plan and implement a comprehensive Mission Assurance program for all flight and ground hardware, software, Ground Support Equipment (GSE), and mission operations. This responsibility extends to all of the mission subcontracts and suppliers. Mission assurance insight is planned by the Earth Explorers Program Office and shall be focused primarily on those activities that contribute most to product integrity. Deliverable documentation may be reduced, provided the mission team maintains an adequate internal record keeping system that provides the necessary traceability to the Earth Explorers Program Office and that is documented in a Mission Assurance Plan. The Earth Explorers Program Office shall support and participate with the mission team in assuring that the mission assurance program being implemented is valid, complete, and effective. The Earth Explorers Program Office is prepared to assist the mission team in any aspect of mission assurance, and to be the mission team's point-of-contact for ready and regular access to the Goddard Space Flight Center's mission assurance expertise.

Earth Explorers missions that are predominately "single string" systems with emphasis on simplicity of design and cost control require a rigorous and disciplined systems engineering effort. Utilization of quality parts and materials and high standards of workmanship, have allowed a limited reliability and quality assurance program, guarded by the test program, to achieve the adequate reliability and mission success. It is recommended that each mission team consider similar approaches that envelope all aspects of the mission development. A philosophy based on hurried design and development, followed by an extensive test and repair program, has been shown to be a costly and unreliable approach.

An agreement between the mission team and the Earth Explorers Program Office on the quality assurance, reviews, safety, design assurance and verification system to be implemented shall be required prior to the confirmation of the mission and shall be documented in a Mission Assurance Plan. This plan is required for review by the Earth Explorers Program Office prior to the agreement. The plan may be developed during a mission study, if one is planned, or during the formulation phase.

2.0 Mission Assurance

2.1 Quality System

The Project/Mission Team shall define and implement a quality system based on ANSI/ASQC Q9001-1994 that meets the intent of ISO 9001. The Project/Mission Team's quality system shall encompass all flight and ground hardware, flight software and ground support equipment development, as well as mission operations.

2.2 Workmanship

The Project/Mission Team shall impose workmanship standards, which help assure that the required mission lifetime and performance are met. The following commercial or NASA workmanship standards are given as guidelines and shall be considered for use:

Soldering of Electrical Connections: NASA Technical Standard NASA-STD-8739.3, Soldered Electrical Connections

Cabling, Harnessing, and Crimping: NASA Technical Standard NASA-STD-8739.4, Crimping, Interconnecting Cables, Harnesses, and Wiring. Note: MIL-STD-1130B, Connections, Electrical, Solderless Wrapped can be used if the missions are planning to use wire wrap for flight hardware or mission critical ground support equipment.

Conformal Coating and Staking: NAS 5300.4(3J-1), Workmanship Standard for Staking and Conformal Coating of Printed Wiring Boards and Electronic Assemblies

ESD Control: NASA Technical Standard NASA-STD-8739.7, Electrostatic Discharge Control (Excluding Electrically Initiated Explosive Devices)

Surface Mount Technology (SMT): NHS 5300.4 (3M), Workmanship Standard for Surface Mount Technology.

Note: SMT processes must be qualified to the mission profile and life expectancy of the mission.

Printed Wiring Board Design: ANSI/IPC-D-275, Design Standard for Rigid Printed Boards and Rigid Printed Board Assemblies, Class 3

Printed Wiring Board Procurement: IPC 6011 and IPC 6012, Class 3 as the basic specification requirements with GSFC S-312-P-003B, Procurement Specification for Rigid Printed Wiring Boards for Space Applications and other High Reliability Uses as a supplement.

The Project/Mission Team and their subcontractors shall provide printed wiring board coupons to GSFC, or to a GSFC approved laboratory, for test, analysis and review.

Fiber Optic: NASA Technical Standard NASA-STD-8739.5, Fiber Optic Terminations, Cable Assemblies, and Installation

Use of other workmanship standards (e.g., MIL-STD, IEEE, IPC, ISO, ANSI, etc.) shall be permitted with the concurrence of the Earth Explorers Program Office.

2.3 Failure Reporting

A documented Failure Reporting System shall be implemented. A problem/failure report shall be written for any departure from design, performance, testing, or handling requirement that affects the function of flight equipment, or ground support equipment that interfaces with flight equipment, or that could compromise mission objectives.

Reporting of failures to the Earth Explorers Program Office shall begin with the first power application at the box, instrument, or spacecraft levels. This reporting shall continue through formal acceptance of the hardware. For software problems, failure reporting shall begin with formal qualification testing of each computer software configuration item or first use of the computer software configuration item with the flight hardware. All failure reporting records shall be submitted to the Earth Explorers System Assurance Manager for information. Either paper or electronic format is acceptable. The Project/Mission Team can use any failure report format they deem acceptable, as long as the Earth Explorers Program Office has concurred with the format. The Project/Mission Team shall maintain failure-reporting records of problems encountered at the lower levels of assembly for information.

3.0 Reviews

The implementation of the mission shall be periodically reviewed by a competent and independent assessment team or teams of experts, to assure that satisfactory progress is being made toward meeting mission requirements.

All system level reviews (see Section 3.1) shall be conducted by GSFC personnel. These reviews shall concentrate on the critical system and end-to-end technical and programmatic aspects of the mission. Additional reviews at the subsystem and system levels shall be conducted by the Project/Mission Team to ensure a detailed examination of the project/mission. The review plan shall thoroughly examine subsystem designs and their interfaces during the formulation subprocess in order to mitigate risk and resolve potential problems without major impact to the project/mission. It shall provide a continual examination of the technical and programmatic progress throughout the implementation subprocess as an ongoing means to reduce risk, address

issues and resolve problems to further ensure mission success. If requested through the Earth Explorers Program Office, the GSFC shall provide technical expertise for participation in these additional reviews. The GSFC is required to assess the thoroughness, competence and independence of the total review process and shall be invited to send representatives to all technical reviews.

A Confirmation Review Process shall also be conducted. These reviews may be coordinated with the Project/Mission Team so that they coincide with other reviews. It is the Project/Mission Team's responsibility to address all concerns and action items identified during these reviews.

3.1 System Reviews

The required reviews for Earth Explorers projects/missions are the System Requirements Review (SRR), Preliminary Design Review (PDR), Mission Design Review (MDR), Confirmation Readiness Review (CRR), Mission Confirmation Review (MCR), Critical Design Review (CDR), Pre- Environmental Review (PER), Pre-Ship/Operational Readiness Review (PSR/ORR), Mission Readiness Review (MRR), and Flight Readiness Review (FRR). Each review chairman, in concert with the Earth Explorers Program Office and GSFC directorates, appoints independent key technical experts as review team members. The Chief Systems Engineer for the Earth Explorers Program Office or his designee shall be a review team member for each of these reviews. Every effort will be made to maintain continuity of the chairman and the key technical experts for the duration of the mission. Other experts shall be added to and/or deleted from the review team, according to the technical needs and phase of the mission. The scope and function of these required reviews is as follows:

System Requirements Review (SRR): The SRR shall be the first major mission review during the Formulation Subprocess. The purpose of this review is to formally examine the agreed-to mission science, operations and technical requirements. Traceability of these requirements shall be demonstrated. The SRR shall be chaired or co-chaired by the GSFC Systems Review Office, Code 301.

Preliminary Design Review (PDR): The PDR shall occur during the Formulation Subprocess, but after final definition of the mission science and technical requirements. The purpose of the PDR is to examine preliminary designs of all mission subsystem and system components for technical feasibility with respect to the mission requirements and to assess the mission design at the subsystem and system levels as it relates to the mission requirements. The PDR shall be chaired or co-chaired by the GSFC Systems Review Office, Code 301.

Mission Design Review (MDR): The MDR shall be held at the end of the mission Formulation Subprocess and shall follow the PDR or be combined with the PDR. It combines the technical findings of the PDR with a programmatic and process review of the proposed mission implementation. The purpose of this review is to confirm:

- final design, fabrication and test plans for each subsystem
- final interface control documents
- mission integration and verification plans
- complete programmatic plan through launch

- requirements flow-down traceability
- risk identification and mitigation plans, including descopes
- comprehensive cost, schedule and resource plans
- complete ground system architecture
- comprehensive system engineering plan
- final definition of mission science requirements
- thoroughly defined roles and responsibilities of all mission team members

The GSFC Systems Review Office, Code 301 and an appointee of the Earth Explorers Program Office shall co-chair the MDR.

Confirmation Readiness Review (CRR): The CRR shall be held after the MDR and is the Earth Explorers program gate for mission approval to proceed into the Implementation Subprocess. The findings from the MDR are presented to the GSFC Governing Program Management Council (GPMC) for consideration and subsequent project/mission confirmation. The results from this review are either Mission Confirmation or conditional Mission Confirmation pending action item closure or Mission Termination.

Mission Confirmation Review (MCR): The GSFC PMC Chair and the Explorers Program Office present the results and recommendations of the CRR to the Associate Administrator, Office of Earth Science for concurrence and final approval for the mission to proceed into the Implementation Subprocess.

Critical Design Review (CDR): The CDR should occur after the design has been completed, but prior to the start of flight hardware manufacturing or coding of the flight software. It shall emphasize implementations of design approaches, mission operations planning, as well as test planning for all flight systems. In the case of long lead procurements, manufacturing may be initiated prior to CDR, if approved by the Earth Explorers Program Office, as required to meet schedule. The CDR shall be chaired or co-chaired by the GSFC Systems Review Office, Code 301.

Pre-Environmental Review (PER): The PER shall assess the readiness of the flight hardware, software and required environmental test facilities to begin acceptance testing. The PER shall also cover:
- design changes since CDR
- status of nonconformances
- test documentation (plans, procedures, waivers) and facilities readiness
- hardware and software configuration
- mission operations status

The PER shall be held prior to the full system integration and functional test in preparation for environmental testing. The PER shall be chaired or co-chaired by the GSFC Systems Review Office, Code 301.

Pre-Ship Review/Operational Readiness Review (PSR/ORR): The mission PSR is conducted at the end of the mission Implementation Subprocess. The mission PSR shall verify that all

system elements meet the requirements of the mission and are ready to proceed into final launch preparations. The mission PSR shall verify that testing has been completed with no unacceptable open issues and to validate the readiness of the flight hardware and software and ground system. Included as part of the above review is the Operations Readiness Review (ORR). This part of the review shall assess the readiness, and document the final details of the approach agreed to be used for flight operations. The mission PSR/ORR shall at a minimum, cover:

- determination of completion of testing flight hardware and software
- verification of system requirements
- verification and documentation of final hardware and software configuration
- identification and status of outstanding safety risks
- disposition of waivers, deviations, open issues
- results of compatibility testing of spacecraft and ground support equipment
- results of end-to-end system level testing and verification
- orbital operations plans
- mission operations, ground system and data processing system readiness
- launch system readiness (interfaces, vehicle)
- evaluation of the acceptance data packages

The result of this review shall be reported at the Mission Readiness Review. The mission operations agreement reached at the ORR cannot be changed without NASA concurrence. The PSR shall be chaired or co-chaired by the GSFC Systems Review Office, Code 301.

Mission Readiness Review (MRR): The MRR is typically held 4-6 weeks prior to launch. The review shall cover all components of mission readiness; project status, science objectives and mission performance, instrument readiness, spacecraft readiness, ground system readiness, launch service readiness and launch site assessment, resolution of all open items, liens and waivers, public affairs plan and other topics as appropriate to ensure all aspects critical to mission success have been reviewed. The MRR is presented to the GSFC Governing Program Management Council (GPMC) for review and certification of the readiness of all mission components to proceed toward launch. The results of the MRR are presented to the Associate Administrator, Office of Earth Science.

Flight Readiness Review (FRR): The FRR shall take place at the launch site just prior to launch. This review is to certify final flight readiness of all mission elements. All open issues from the MRR must be resolved before the FRR.
The GSFC Systems Review Office, Code 301, shall chair the FRR.

3.2 Peer Reviews

The Project/Mission Team shall focus resources on engineering working-level reviews (peer reviews) throughout the mission formulation and implementation subprocesses to identify and resolve concerns prior to formal, system level reviews. Engineering peer reviews are required and typically occur during all phases of the project life cycle. These reviews are expected to present more detail than system-level formal reviews. Peer review is defined as a detailed independent engineering design review focused at the Subsystem and box level, conducted informally with recognized internal or external experts having current detailed knowledge of the

design specialties associated with the item under review. Primary design documentation, such as drawings, schematics, wiring diagrams, and analyses are the review vehicles. Its purpose is to substantiate a detailed understanding of the design's ability to meet all of its performance and interface requirements, to surface correctable problems early, and to ensure best known practices are used that enhance robustness by avoiding known or predictable problems.

The intent of the peer reviews is to have participants gain a detailed understanding of component and subsystem design and assess the ability to meet higher level system and mission requirements. Effective peer reviews will enable the content of higher level formal reviews described in Section 3.1 to be significantly streamlined.

For each review a written record shall be kept of time, place, and attendees. Timely, accurate insight, through action item documentation and follow-up activities, is vital to the process. The Project/Mission Team's quality system shall track and close-out all actions items identified during these peer reviews to ensure that issues are resolved promptly, at the lowest levels and before system level reviews. A list of action items and responses or closure plans from each peer review shall be maintained by the Project/Mission Team's quality system and shall be made available to the Earth Explorers Program Office at least one week prior to the subsequent system-level formal review. The results of the peer reviews and all open action items with closure plans shall be presented at the system-level formal review.

To promote continuity of the entire review program, the Systems Review Office and the Earth Explorers Program Office shall be invited to attend and participate in any peer review session held by the Project/Mission Team. Upon request, the program office can supply technical expertise as required for participation in the areas undergoing peer reviews.

Some of the topics that shall be addressed in the peer reviews are as follows:

- interface control design verification
- parts and materials review
- analysis and studies
- safety issues
- risk assessment, resolution and contingency plans
- procurements
- confirmation of technology items
- hardware and software configuration management
- detailed cost, schedule and resource availability
- manufacturability and testability
- integration and test planning, including test anomalies and resolution

4.0 Design Assurance

4.1 Parts

The Project/Mission Team shall implement a parts program that assures mission reliability and performance requirements are met. GSFC 311-INST-001, Instructions for EEE Parts Selection, Screening, and Qualification, shall be used as a guide in selecting and processing parts.

The Project/Mission Team shall control the management, selection, application, evaluation, and acceptance of all parts through a Parts Control Board, or another similar documented parts control system. Board members shall be responsible for the review and approval of all parts for conformance to the GSFC 311-INST-001. The Board shall define any parts screening, Destructive Physical Analysis and other tests needed to insure that mission and performance requirements will be met. The Board shall maintain an EEE Parts Identification List prior to and during the Project/Mission Team's hardware built. This list shall be updated and submitted as part of the Mission Readiness Review. The final as-built list shall be provided as part of the hardware documentation package.

The Project/Mission Team shall have access to and maintain knowledge of parts problems as reported in the Government Industry Data Exchange Program (GIDEP). Any provided NASA Alerts shall also be reviewed.

All Electrical, Electronic, and Electro-mechanical (EEE) parts shall be derated in accordance with the guidelines specified in GSFC PPL-21, Appendix B. The Project/Mission Team shall be responsible for the implementation and verification of the derating guidelines.

System design and EEE parts selection shall be such that their intended application shall be met in the predicted mission radiation environment. The resulting design shall be latch-up immune and shall minimize Single Event Upsets (SEU.)

4.2 Materials and Processes

The Project/Mission Team shall implement a Materials and Processes program. NASA Reference Publication 1124 entitled "Outgassing Data for Selecting Spacecraft Materials" shall be used as a guide for materials selection on this program. Materials that have a total mass loss (TML) <1.00% and a collected volatile condensable mass (CVCM) <0.10% shall be used on this program. If requested, the Earth Explorers Program Office may provide technical guidance in this area.

Fastener selection and use shall be controlled. GSFC S-313-100, Goddard Space Flight Center Fastener Integrity Requirements, shall be used as a guide.

Materials selected shall meet the stress corrosion cracking requirements of MSFC-SPEC-522.

Each Project/Mission Team shall maintain a list of materials (polymeric, composites and inorganic), lubricants, processes, and appropriate usage records prior to and during the hardware development. This list shall be updated and submitted as part of the Mission Readiness Review. The final as-built list shall be provided as part of the final hardware documentation package.

4.3 Reliability

The Project/Mission Team shall plan and implement a reliability program that interacts with other mission disciplines including systems engineering, hardware design, parts selection, and

systems safety. This program shall be conceived and organized to effectively, efficiently, and responsively to perform tasks which enhance the expected mission lifetime. The Project/Mission Team shall develop and implement a program plan that addresses mission objectives, assigns responsibilities, and schedules tasks relative to program milestones. The reliability program, at a minimum, shall address the following objectives:

I. Design

a) Graceful degradation is a design objective.
b) Reduce series complexity by eliminating unnecessary parts and components.
c) Promote failure workarounds that allow continued successful but degraded operation.
d) By design, wherever practicable, failures shall allow continued successful, albeit degraded operation.
e) Isolate failure impact so that effects do not propagate to other functions.
f) Failure of non-critical functions shall not affect critical functions.
g) Show that electrical stress applied to parts and devices meets derating requirements over the extremes of operating temperature range, voltage temperature range, and current variations.
h) Parts meet total dose and single event effects radiation requirements.
i) Verification that a consistent reliability process is flowed down to subcontractor(s) and suppliers.

II. Manufacture

a) An in-process inspection program that verifies hardware is assembled as designed.
b) A verification program that assures specified manufacturing processes are followed.

III. Test

a) A test program that verifies finished product meets specification.
b) A test program that verifies finished product functions as designed.

A Failure Modes and Effects Analysis (FMEA) shall be performed early in the design process to identify problem areas that do not meet these objectives and corrective action shall be recommended. The FMEA shall be updated as the design matures. GSFC Procedure No. S-302-89-01 entitled "Procedures for Performing a Failure Modes and Effects Analysis" and/or MIL-STD-1629A, "Procedures for Performing a Failure Mode, Effects and Critical Analysis" can be used as guides. The FMEA shall be available for review by the Earth Explorers Program Office. Worst case circuit analysis shall be performed for electrical and electronic component designs. Flight software timing and sizing utilizations and margins (memory, CPU throughput, and Bus I/O) shall be documented and updated periodically throughout the life of the Project/Mission.

Fault Tree Analyses (FTA) and Probability Risk Assessments (PRA) shall be performed and the results shall be made available for Earth Explorers Program Office review.

4.4 Software

The Project/Mission Team shall employ a formal, systematic program for the development of software using the guidelines of ISO 9000-3:1991. The program shall address appropriate development life cycle phases such as: requirements analysis, design, code and unit test, integration and build test, performance verification, and maintenance. Code produced shall be structured, error-free, and maintainable. Verification and Validation (V&V) and Independent

Verification and Validation (IV&V) processes shall be developed and implemented for the software.

During the preliminary design process, the Project/Mission Team shall establish and document software requirements and any appropriate external interface specifications and user guides. The Project/Mission Team shall participate in a program of internal and external software reviews to validate software requirements, design, operating characteristics, and external interface requirements. Recommended software reviews shall include, as a minimum, a Software Requirements Review, Software Preliminary (Architectural) Design Review, Software Critical (Detailed) Design Review, Software Test Readiness Review, Software Acceptance Review.

The Project/Mission Team shall employ a software configuration management process to manage requirements, code, documentation, and data, and to track and report on the status of changes to them. The process shall include a software problem reporting and corrective action system to track and disposition identified discrepancies in the product.

5.0 Verification

Each Project/Mission Team shall conduct a verification program to ensure that the flight hardware meets the specified mission requirements. The program shall consist of functional demonstrations, analytical investigations, physical measurements and tests that simulate all expected environments. Each Project/Mission Team shall provide adequate verification documentation including a verification plan and matrix, environmental test matrix, and verification procedures.

Guidelines for developing a verification program are contained in the GSFC General Environmental Verification Specification for STS and ELV Payloads, Subsystems and Components (GEVS), which is available on the World Wide Web at the following URL: http://arioch.gsfc.nasa.gov/302/verifhp.htm.

6.0 Contamination

The Project/Mission Team shall identify contamination requirements, and establish and maintain a contamination control program consistent with mission requirements.

7.0 Independent Mission Operations Requirements

Missions being operated by a Principal Investigator (PI) independent of NASA must meet the following additional requirements. After on-orbit checkout, incident reports must be provided to the GSFC Earth Science Mission Operations (ESMO) Project in accordance with "GSFC Flight Program Incident Reporting System Guidelines". Weekly on-orbit status summary reports shall be provided to ESMO. It is the PI institution's responsibility to contractually ensure the

availability of spacecraft developer support of anomaly resolution efforts during the mission's operational phase. Structured management approaches to risk management and orbital mission configuration control must be in place during the operational phase. An annual mission risk assessment status report shall be provided to ESMO.

8.0 Red Team Reviews

Red Team Reviews shall be implemented as part of the review process beginning at CDR. These reviews will enhance the probability of mission success by bringing to bear additional technical expertise to review all mission critical aspects of each program.

The mission elements to be fully addressed and evaluated during the review process shall be as follows:

- Spacecraft/Instruments/Initial operations safety
- Payload to launch vehicle integration
- Launch vehicle mission unique changes
- Unique-to-mission operations

SOMO/Institutional mission operations shall be addressed on a mission unique requirements basis only. Mission science operations shall be limited to systems needed for data capture, processing, archiving and distribution only.

The reviews shall consist of a critical technical implementation and operations review on each individual mission from the perspective of looking at what could go wrong and cause the mission to be less than fully successful. Specific key processes used by the project in the implementation of the mission shall be reviewed. The results of some of these key processes shall be reviewed and assessed as well. From this information the Review Team shall identify and document all remaining risk that could prevent complete mission success. Each Project shall be required to assemble all pertinent information (using specific formats) and present that information to the Review Team.

Addressing all of the in-scope mission elements as specified above, the Project shall assemble and present data in specified formats, that addresses (or provides) the following:

1. The level, competence and independence of technical peer reviews that were performed on each of the elements and components.
2. The performance, level and independence of system level reviews that were conducted.
3. The level and thoroughness to which the test and verification program was implemented. The test and verification program at all levels from black box to spacecraft and integrated mission shall be detailed. This shall also include the V&V and IV&V processes used on software.
4. The level of mission assurance that was imposed on the implementation of the mission. This shall include parts usage as well as workmanship standards imposed. It shall also address the software assurance processes implemented.
5. The systems management imposed and implemented the mission. This shall include the performance and thoroughness of analyses, requirement management, systems engineering,

software metrics, configuration management, documentation and technical record-keeping and workmanship and test process management.

6. Factors such as staffing and the experience of the implementing organization.
7. The results of the test and integration process of all of the hardware and software elements of the mission. This shall include information on the review and assessment of all failures and anomalies and their resolution.
8. Information on the failure-free as well as the total operating time on all mission critical hardware and software.
9. The results of the technical review process shall be detailed. It shall include an assessment of all RFAs and the Project responses to those RFAs.
10. The amount, level and fidelity of mission simulations and launch/operations training that was done or is planned to be done to prepare the mission for launch and on orbit operations including identification of all planned contingency operations and of those operations which were or will be practiced by the operations team. Identify any green card exercises (postulated mission contingencies which require action by the operations team) planned or conducted with the operations team. Provide a spacecraft mission timeline from liftoff to commencement of normal science operations and identify for each step the corrective action to be taken if the mission event does not occur as planned.
11. Provide the Failure Mode and Effects Analyses (FMEA) and the Fault Tree Analyses (FTA) that were performed for the program with appropriate annotations and tutorials. Provide the results of the Probability Risk Assessments (PRA) and Worst Case Circuit Analyses (WCCAs) that were performed.
12. The amount, level and fidelity of mission simulations and launch/operations training that was done or is planned to be done to prepare the mission for launch and on orbit operations.
13. Provide a mission requirements Verification Matrix that shows the pre launch verification of the mission level requirements. This matrix shall address both the fidelity and type of verification.
14. Identify all single point failures and provide a subjective assessment of the probability of each such failure mode causing a mission failure. Also provide adequate rationale to substantiate the subjective assessment.

In reviewing the above items, the Review Team shall focus on implementations that could contain unevaluated risk to mission success.

9.0 Continuous Risk Management

All Project/Mission Teams shall implement a Continuous Risk Management System (CRMS) that provides for the identification; analysis; tracking; communication; resolution; mitigation; and retirement of Project/Mission Risks. The CRMS shall include the development; maintenance; and presentation of a Mission Top Ten Risk List. This list will include a description of the risk, along with a mitigation/elimination strategy and status. The CRMS shall be implemented in accordance with the guidelines set forth in the Earth Explorers Risk Management Plan (470-PLAN-007).

APPENDIX I

GENERAL INSTRUCTIONS AND PROVISIONS

[Per NFS 1872.705-1]

I. Instrumentation and/or Ground Equipment

By submitting a proposal, the investigator and institution agree that NASA has the option to accept all or part of the offeror's plan to provide the instrumentation or ground support equipment required for the investigation or NASA may furnish or obtain such instrumentation or equipment from any other source as determined by the selecting official. In addition, NASA reserves the right to require use, by the selected investigator, of Government instrumentation or property that becomes available, with or without modification, that meets the investigative objectives.

II. Tentative Selections, Phased Development, Partial Selections, and Participation with Others

By submitting a proposal, the investigator and organization agree that NASA has the option to make a tentative selection pending a successful feasibility or definition effort. NASA has the option to contract in phases for a proposed experiment, and to discontinue the investigative effort at the completion of any phase. The investigator should also understand that NASA may desire to select only a portion of the proposed investigation and/or that NASA may desire the individual's participation with other investigators in a joint investigation, in which case, the investigator will be given the opportunity to accept or decline such partial acceptance or participation with other investigators prior to a NASA selection. Where participation with other investigators as a team is agreed to, one of the team members will normally be designated as its team leader or contact point.

III. Selection Without Discussion

The Government reserves the right to reject any or all proposals received in response to this AO when such action shall be considered in the best interest of the Government. Notice is also given of the possibility that any selection may be made without discussion (other than discussions conducted for the purpose of minor clarification). It is therefore emphasized that all proposals should be submitted initially on the most favorable terms that the offeror can submit.

IV. Foreign Proposals

See AO Section 3.3.3.

V. Treatment of Proposal Data

It is NASA policy to use information contained in proposals and quotations for evaluation purposes only. While this policy does not require that the proposal or quotation bear a restrictive notice, offerors or quoters should place the following notice on the title page of the proposal or quotation and specify the information subject to the notice by inserting appropriate identification, such as page numbers, in the notice. Information (data) contained in proposals and quotations will be protected to the extent permitted by law, but NASA assumes no liability for use and disclosure of information not made subject to the notice. To prevent inadvertent disclosure, proposal data shall not be included in submissions (e.g., final reports) that are routinely released to the public.

RESTRICTION ON USE AND DISCLOSURE OF
PROPOSAL AND QUOTATION INFORMATION (DATA)

The information (data) contained in [insert page numbers or other identification] of this proposal or quotation constitutes a trade secret and/or information that is commercial or financial and confidential or privileged. It is furnished to the Government in confidence with the understanding that it will not, without permission of the offeror, be used or disclosed for other than evaluation purposes; provided, however, that in the event a contract is awarded on the basis of this proposal or quotation the Government shall have the right to use and disclose this information (data) to the extent provided in the contract. This restriction does not limit the Government's right to use or disclose this information (data) if obtained from another source without restriction.

VI. Status of Cost Proposals (U.S. Proposals Only)

The investigator’s institution agrees that the cost proposal is for proposal evaluation and selection purposes, and that following selection and during negotiations leading to a definitive contract, the institution may be required to resubmit cost information in accordance with FAR 15.403-5.

VII. Late Proposals

Proposals or proposal modifications received after the latest date specified for receipt may be considered if a significant reduction in cost to the Government is probable or if there are significant technical advantages, as compared with proposal previously received.

VIII. Source of Space Transportation System Investigations

Investigators are advised that candidate investigations for Space Transportation System (STS) missions can come from many sources.

IX. Disclosure of Proposals Outside Government

NASA may find it necessary to obtain proposal evaluation assistance outside the Government. Where NASA determines it is necessary to disclose a proposal outside the Government for evaluation purposes, arrangements will be made with the evaluator for appropriate handling of the proposal information. Therefore, by submitting a proposal, the investigator agrees that NASA may have the proposal evaluated outside the Government. If the investigator or institution desire to preclude NASA from using an outside evaluation, the investigator or institution should so indicate on the cover. However, notice is given that if NASA is precluded from using outside evaluation, it may be unable to consider the proposal.

X. Equal Opportunity (U.S. Proposals Only)

By submitting a proposal, the investigator and institution agree to accept the following clause in any resulting contract:

EQUAL OPPORTUNITY

During the performance of this contract, the Contractor agrees as follows:

(a) The Contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin.

(b) The Contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment without regard to their race, color, religion, sex, or national origin. This shall include, but not be limited to, (1) employment, (2) upgrading, (3) demotion, (4) transfer, (5) recruitment or recruitment advertising, (6) layoff or termination, (7) rates of pay or other forms of compensation, and (8) selection for training, including apprenticeship.

(c) The Contractor shall post in conspicuous places available to employees and applicants for employment the notices to be provided by the Contracting Officer that explains this clause.

(d) The Contractor shall, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, or national origin.

(e) The contractor shall send to each labor union or representative of workers with which it has a collective bargaining agreement or other contract or understanding the notice to be provided by the Contracting Officer, advising the labor union or workers' representative of the Contractor's commitments under this clause, and post copies of the notice in conspicuous places available to employees and applicants for employment.

(f) The Contractor shall comply with Executive Order 11246, as amended, and the rules, regulations, and orders of the Secretary of Labor.

(g) The Contractor shall furnish to the contracting agency all information required by Executive Order 11246, as amended, and by the rules, regulations, and orders of the Secretary of Labor. Standard Form 100 (EEO-1), or any successor form, is the prescribed form to be filed within 30 days following the award, unless filed within 12 months preceding the date of award.

(h) The Contractor shall permit access to its books, records, and accounts by the contracting agency or the Office of Federal Contract Compliance Programs (OFCCP) for the purposes of investigation to ascertain the Contractor's compliance with the applicable rules, regulations, and orders.

(i) If the OFCCP determines that the Contractor is not in compliance with this clause or any rule, regulation, or order of the Secretary of Labor, the contract may be canceled, terminated, or suspended in whole or in part, and the Contractor may be declared ineligible for further Government contracts, under the procedures authorized in Executive Order 11246, as amended. In addition, sanctions may be imposed and remedies invoked against the Contractor as provided in Executive Order 11246, as amended, the rules, regulations, and orders of the Secretary of Labor, or as otherwise provided by law.

(j) The Contractor shall include the terms and conditions of subparagraph 1 through 9 of this clause in every subcontract or purchase order that is not exempted by the rules, regulations, or orders of the Secretary of Labor issued under Executive Order 11246, as amended, so that these terms and conditions will be binding upon each subcontractor or vendor.

(k) The Contractor shall take such action with respect to any subcontract or purchase order as the contracting agency may direct as means of enforcing these terms and conditions, including sanctions for non-compliance; provided, that if the Contractor becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of direction, the Contractor may request the United States to enter into the litigation to protect the interests of the United States.

XI. Patent Rights

(a) For any contract resulting from this solicitation awarded to other than a small business firm or nonprofit organization, the clause at NFS 1852.227-70, "New Technology", shall apply (suitably modified to identify the parties). Such contractors may, in advance of contract, request waiver of rights as set forth in the provision at NFS 1852.227-71, "Requests for Waiver of Rights to Inventions".

(b) For any contract resulting from this solicitation awarded to a small business firm or nonprofit organization, the clause at FAR 52.227-11, "Patent Rights--Retention by the Contractor (Short Form)" (as modified by NFS 1852.227-11) shall apply (suitably modified to identify the parties).

[Per NFS 1852.227-14]

XII. Data Rights

For any NASA contract resulting from this solicitation, the clause at FAR 52.227-14, "Rights in Data – General" (as modified by NFS 1852.227-14) shall apply (suitably modified to identify the parties).

[Per FAR 52.219-8 and NFS 1852.219-76]

XIII. Participation Of Small, Small Disadvantaged, And Women-Owned Small Businesses, And Minority Institutions

Offerors are advised that, in keeping with Congressionally mandated goals, NASA seeks to place a fair portion of its contract dollars, where feasible, with small business concerns, veteran-owned small business concerns, service-disabled veteran-owned small business concerns, HUB Zone small business concerns, small disadvantaged business concerns, and women-owned small business concerns, Historically Black Colleges and Universities (HBCUs), and other minority educational institutions (OMIs), as these entities are defined in 52.219-8 and 52.226-2 of the FAR. Offerors will be evaluated on the participation in the performance of the mission of small disadvantaged business concerns in the authorized North American Standard Industrial Classification (SIC) Groups as determined by the Department of Commerce (see FAR 19.201(b)), as well as the participation o women-owned small business concerns, HBCUs and OMIs.

NASA contracts resulting from this solicitation which offer subcontracting possibilities, exceed $500,000, and are with entities other than small business concerns, will contain the clause at FAR 52.219-9. Offerors who are selected under the Step-Two Evaluation Process under this AO, and who meet the foregoing conditions, will be required to negotiate appropriate subcontracting plans. Failure to submit and negotiate a subcontracting plan shall make the offeror ineligible for an award.

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APPENDIX J

FLIGHT AND GROUND SAFETY REQUIREMENTS

Note: This Appendix to the ESSP AO describes the general Flight and Ground Safety Requirements for Earth Explorers at the NASA Goddard Space Flight Center, and is representative of the requirements at other NASA Centers. NASA headquarters will determine which NASA Center will monitor your mission implementation at the time of mission selection.

PREFACE

The purpose of this document is to serve as a resource to the Project/Mission Team of each Earth Explorers project/mission for complying with necessary NASA safety requirements.

1.0 Overview

1.1 PURPOSE

All Mission/Project Teams shall establish, implement and maintain a system safety program in accordance with the following requirements:

- Identifies and controls hazards to personnel, facilities, support equipment, and the flight system during all stages of mission/project development. The safety program shall address hazards in the flight hardware, associated software, ground support equipment, and support facilities.
- Meets the system safety requirements stated in the applicable launch site safety regulation.
- Meets the baseline industrial safety requirements of each mission/project team member's institution, as well as any special contractually imposed mission/project unique obligations.

The safety program shall be documented in a Safety Plan for each Mission/Project, and shall apply to all work performed by the Mission/Project, its subcontractors and suppliers, and Mission Team members.

2.0 Flight Systems

2.1 FLIGHT SYSTEMS (Hardware & Software)

Flight hardware and software systems developers shall implement a system safety program in accordance with the requirements imposed by the appropriate launch range and the launch vehicle manufacturer or launch service provider. The requirements are mandatory and are not negotiable, but may be tailored to the extent that not all requirements apply to every project/mission. The tailoring of the requirements to the specific mission is done with the applicable launch range safety organization.

Each project/mission shall comply with the "NASA Policy for Limiting Debris Generation" (NPD 8710.3) and the NASA Safety Standard "Guidelines and Assessment Procedure for Limiting Orbital Debris" (NSS 1740.14). Each Project/Mission Team shall be responsible for performance of the required orbital debris assessment.

The following are mandatory compliance requirements for hardware and software intended to be launched on any of the various launch vehicles/launch services. The Mission/Project Team ensures compliance with the requirements and certifies to the launch range, in the form of the Safety Data Package, that all of the requirements have been met.

The following documents describe the complete safety program implementation and deliverables required to safely launch space hardware. The documents reference other requirements that the flight system developer must also meet to gain access to the launch site and subsequent launch.

3.0 Documentation

3.1 TOP LEVEL SAFETY REQUIREMENTS DOCUMENTS

Any payload (ELV or Shuttle) using Kennedy Space Center (KSC) facilities for testing, integration, etc. (including those at Eastern Test Range (ETR) and Western Test Range (WTR) where KSC has jurisdiction for reviewing procedures and facilities) shall comply with KHB 1710.2C, "Kennedy Space Center Safety Practices Handbook."

For Shuttle Missions:

1) NSTS 1700.7B, "Safety Policy and Requirements for Payloads Using the Space Transportation System."

2) 45 SPW S-100/KHB 1700.7B, "Space Shuttle Payload Ground Safety Handbook."

For ELV Missions at ETR or WTR:

EWR 127-1, "Eastern and Western Range Safety Requirements."

For Wallops Flight Facility (WFF) Missions:

RSM-93, "Range Safety Manual for Goddard Space Flight Center (GSFC)/Wallops Flight Facility (WFF)."

For Missions flying on the Pegasus launch vehicle:

1) "Pegasus Design Safety Requirements Document" (SSD TD-0005) (currently Rev B).
2) "Pegasus Safety Requirements Document for Ground Operations" (SSD TD-0018) (currently Rev A).

APPENDIX K

PROPOSAL FORMAT AND CONTENT

The following guidelines apply to the preparation of proposals in response to this ESSP AO. The material presented is a guide for the prospective proposer, and is not intended to be all encompassing. The proposer shall, however, provide information that is relative to those items applicable, as well as other items required by the AO. In the event of an apparent conflict between the guidelines in this Appendix and those contained within the body of the AO, those within the AO shall take precedence. Note that this appendix provides format and content guidelines that apply to both Step-One and Step-Two proposals. Table K-1 specifies the page limits for each step in the proposal process. Remember that the Step-One evaluation is intended to assess the in-depth scientific/applications merits, justification and maturity of the proposed investigation in relation to the ESSP research objectives and scientific questions. However, all of the sections shall be covered but in varying degrees of detail as indicated by the page limits in Table L-1. Guidelines for the Mission Confirmation Review can be found in Appendix D. The Compliance Table (see Table K-3) in intended to help the proposer ensure that all requirements have been covered in the proposal. However, the table may not cover every required element and it is the proposers responsibility to include all required elements in the proposal. If NASA selects a Step-One proposal the PI will be requested to submit a Step-Two proposal. Failure to follow all proposal formats; content and other instructions may result in reduced ratings during the evaluation process and could lead to rejection of the proposal.

FORMAT GUIDELINES

All documents shall be single-spaced typewritten in English (without reduction), use the International System (SI) of units, and be clearly legible. All cost estimates, including non-U.S. contributions, shall be in U.S. dollars. Submission of proposal material by facsimile (fax), electronic media, videotape, floppy disk (except as noted below), etc., is not acceptable. In evaluating proposals, NASA will only consider printed material. Although you are allowed to provide references to published papers, World Wide Web sites, etc., your proposal cannot rely upon these. The Evaluation panels are not obligated to check or refer to these references.

The Step-One proposal shall consist of one volume; however, the Step-Two proposal **shall** consist of two volumes, with readily identified sections corresponding to the sections identified in Table K-1. **Note** the requirements on page count for the various sections of Step-One and Step-Two proposals specified in Table K-1. Step-Two proposals (originals and copies) shall be provided in 3-ring loose-leaf binders.

In order to allow for recycling of proposals after the review process, all proposals and copies shall be submitted on plain white paper only (e.g., no cardboard stock or plastic covers, no colored paper, etc.). Photographs and color figures are permitted if printed on recyclable white paper only. The original signed copy shall be bound in a manner that makes it easy to disassemble for reproduction. Except for the original, two-sided copies are preferred. Every side upon which printing appears will be counted against the page limits.

Table K-1. Proposal Page Count Limits

Volume	Section	Section Name	Page Limits	
			Step-One	**Step-Two**
I	A	Cover Page	1 page (not part of proposal limit)	
	B	Investigation Summary	Use ESSP Forms I & II **only** (not part of proposal limit)	
	C	Fact Sheet	1 page (front & back; not part of proposal limit)	
	D	Table of Contents	No limit (not part of proposal limit)	
	E	Endorsements	1 page (not part of proposal limit)	
	F	Science/Applications Investigation	12 pages	25 pages
	G	Technical	2 pages	50 pages
	H	Management	1 pages	25pages
	I	Cost and Cost Estimating Methodology Summary	2 pages	2 pages
	J	Education	1 page	10 pages
	K	Other Opportunities	1 page	12 pages
	L	Appendices:	No page limit, but small size encouraged	No page limit, but small size encouraged
II	A	Cover page (copy of section A)	0 pages (not required for Step-One Proposals)	1 page (not part of proposal limit)
	M	Cost Methodology and cost Estimating Details	0 pages	No limit

Table K-2 gives specifics of the required proposal page format. Figure captions shall be in 12 point. Smaller font is allowed within figures, Investigation Summary Forms, and in the cost table.

Table K-2. Format and Layout.

Page Size	8.5X11 inches or A4 European standard
Page Layout	Single or Double-Column
Margins	1 inch top and bottom 1 inch left and right sides
Lines per page	55 lines max
Foldout pages	Step-One: none Step-Two: **Maximum** 4 pages; 11 x 17 inches
Font size	No smaller than 12-point Times (approx. 15 characters per inch)
Proposal Binding	Step-Two: 3-Ring loose leaf binders

As described in Sections 4.2.3 of this Announcement, the proposal shall also be provided on zip disks or CD ROM containing electronic versions of the proposal, along with a brief description of the contents of the electronic media. All information shall be provided on DOS-compatible (version 5.0 or higher) zip disks or CD ROM and in pdf and Microsoft Word for Windows format (version 6.0 or later) or Microsoft Excel Version (windows 95 or later).

Do not include information on the electronic media that is not included in the paper volumes of the proposal. If the electronic media are found to include information that differs from the paper volume or are found to be defective (e.g., non-readable) the electronic media will be returned to the proposer and the proposer shall promptly provide replacement media. These replacement media will not be considered a late proposal under NFS 1872.705-1 VII. Electronic media **shall** be checked for computer viruses before submission.

If you find it necessary to segment the proposal on multiple electronic media either because of space or other limitations, the files should be as large as possible and have a logical relationship to the proposal structure. Also provide a brief description explaining the file structure, naming conventions, and other information that the proposer feels may be helpful to use these files. Include the name of the proposal, name of the PI with telephone number, name and version of the software used to check the disks for computer viruses. The PI shall sign this page certifying the electronic media is virus free. These pages do not count toward the proposal pages limit.

PROPOSAL CONTENT GUIDELINES

The Step-One and Step-Two outline and content are described below. See Table K-1 for page limits for each Step and Section in the proposal process. Only the high level table of contents given in Table K-1 is required (i.e., Sections A through L). The lower level subsection headings are advisory. Proposers shall also refer to the evaluation criteria listed in Section 5 of the AO to ensure that the proposal address the factors NASA will use to evaluate the investigation.

An AO requirements Compliance Table is provided in Table K-3. It is intended to help ensure that all requirements have been included in a proposal. However, the table may not include

every requirement and it is the responsibility of the proposer to ensure that all requirements have been included in the proposal.

Table K-3. Compliance Table

Item	Requirement	Required for		Included
		Step-One	Step-Two	
1	Cover Page	✓	✓	
2	Investigation Summary (Forms I and II)	✓	✓	
3	Fact Sheet	✓	✓	
4	Table of Contents	✓	✓	
5	Endorsements	✓	✓	
6	Science/Applications Investigation	✓	✓	
7	Baseline Science/Applications Mission	✓	✓	
8	Minimum Science/Applications Mission	✓	✓	
9	Instrumentation Technical Maturity Matrix	✓	✓	
10	Science Traceability Matrix	✓	✓	
11	Instrument Information Table	✓	✓	
12	Technical Implementation	✓	✓	
13	Work Breakdown Structure	✓	✓	
14	Launch Services Table	✓	✓	
15	Data Systems	Optional	✓	
16	Mission Traceability Matrix	✓	✓	
17	Mission Design Table(s)	✓	✓	
18	Instrument Implementation Table	Optional	✓	
19	Instrument Characterization Table	Optional	✓	
20	Spacecraft Technical Maturity Matrix	Optional	✓	
21	Spacecraft Characteristics Table	Optional	✓	
22	Manufacturing, Integration and Test Strategy	Optional	✓	
23	Mission Operations, Ground and Data Systems Table	Optional	✓	
24	Plans to Resolve Open Technical Implementation Issues	Optional	✓	
25	Management Processes and Plans	✓	✓	
26	Principal Investigator	✓	✓	
27	Project Manager	Optional	✓	
28	Co-Investigators	Optional	✓	
29	Mission Schedule	✓	✓	
30	Mission Reviews	Optional	✓	
31	Risk Management Plan	Optional	✓	

Item	Requirement	Required for		Included
		Step-One	Step-Two	
32	Mission Assurance and Safety	Optional	✓	
33	Mission Assurance Compatibility Table	Optional	✓	
34	Facilities and Equipment	Optional	✓	
35	Plans to Resolve Open Management Issues	Optional	✓	
36	Preliminary Mission Definition and Requirements Agreement Appendix	Optional	✓	
37	Draft Incentive Plan Appendix	Optional	✓	
38	Relevant Experience and Past Performance Appendix	Optional	✓	
39	Draft International Agreements Appendix	Optional	✓	
40	Contractual Requirements Appendix	Optional	✓	
41	Cost and Cost Estimating Methodology Summary	✓	✓	
42	NASA Mission Cost in Real Year Dollars	Optional	✓	
43	Contributions	Optional	✓	
44	Total Mission Life Cycle Cost Phasing in Real Year Dollars	Optional	✓	
45	Plans to Resolve Open Cost Issues	Optional	✓	
46	Education	Optional	✓	
47	Small, Small Disadvantaged, and Women/Veteran-owned Small Businesses and Minority Institutions	Optional	✓	
48	Commercialization	Optional	✓	
49	Plans to Resolve Open Other Opportunity Issues	Optional	✓	
50	Resumes	✓	✓	
51	Letters of Endorsement	Optional	✓	
52	Civil Rights Certification	Optional	✓	
53	Certification Regarding Lobbying	Optional		
54	Verification Regarding Debarment, Suspension, and Other Responsibility Matters Primary covered Transactions	Optional	✓	
55	Statement of Work	Optional	✓	
56	Acronyms List	Optional	Optional	
57	Reference List	Optional	Optional	
58	Cost and cost Estimating Details	Not Req.	✓	
59	Summary of Elements of Cost	Not Req.	✓	
60	Electronic Version of Proposal	Not Req.	✓	

A. COVER PAGE

A cover page shall be a part of the proposal, but will not be counted against the page limit. The Principal Investigator and an official by title of the investigator's organization that is authorized to commit the organization shall sign the cover page. The full names of the Principal Investigator and the authorizing official, their addresses with zip code, telephone and fax numbers, and electronic mail addresses, shall be included.

Note within the constraints of the page limits:
Step-One proposals at minimum shall cover the following item(s).

1. **Cover Page shall be included**

Step-Two proposals at minimum shall cover the following item(s).

1. **Cover Page shall be included**

B. INVESTIGATION SUMMARY

A summary of the proposed investigation shall be included with the proposal immediately following the cover page. ESSP Forms I and II are to be used for this Summary and are located at the end of this Appendix K. Continuation sheets are **not** allowed. The Investigation Summary is not counted against the page limit.

Note within the constraints of the page limits:
Step-One proposals at minimum shall cover the following item(s).

1. **Investigation Summary shall be included**

Step-Two proposals at minimum shall cover the following item(s).

1. **Investigation Summary shall be included**

C. FACT SHEET

A one-page fact sheet is required and does not count against the proposal page count. This fact sheet should cover the most important aspects of the proposed mission. Items that shall be included are mission statement, science objective and description along with Minimum Science/Applications Mission, concept diagrams of instrument and/or spacecraft, team, schedule with major milestones and launch date, cost and reserves, and launch vehicle. NASA will use this Fact Sheet, in viewgraph form, to summarize your proposal during the evaluation.

Note within the constraints of the page limits:
Step-One proposals at minimum shall cover the following item(s).

1. **Fact Sheet shall be included**

Step-Two proposals at minimum shall cover the following item(s).

1. **Fact Sheet shall be included**

D. TABLE OF CONTENTS

The proposal shall contain a table of contents, which will not be counted against the page limit. This table of contents shall parallel the outline provided in Table K-1 and below in Sections E through M.

Note within the constraints of the page limits:
Step-One proposals at minimum shall cover the following item(s).

1. **Table of Contents shall be included**

Step-Two proposals at minimum shall cover the following item(s).

1. **Table of Contents shall be included**

E. ENDORSEMENTS

A maximum of one page can be used to describe the endorsements proposed. This one page summary and the letters of endorsement are not included in the maximum page count. All co-investigators, lead team members and non-U.S. endorsements shall be included as part of the proposal. Letters of endorsement shall be provided from the following:

- Participants/Organizations in the proposal including NASA participants/organizations,
- All organizations offering goods and/or services on a no-exchange-of-NASA-funds basis,
- Non-U.S. organizations providing hardware or software to the investigation,
- Launch Service provider, if the launch service is not provided through a NASA contract.

Letters of endorsement shall be signed by institutional and Government officials authorized to commit their organizations to participation in the proposed investigation and shall include the signature, full name, address with zip code, telephone and fax numbers, and electronic mail address. These letters shall describe the offered goods/services and their associated value/cost. The letters of endorsements shall be included in Section K of the proposal.

The institutions and/or governments involved shall endorse any participation by non-U.S. individuals and/or institutions as team members or contributors to ESSP investigations. Institutional endorsement is required for contributions. If government support is required then a government endorsement is also required. The letter of endorsement shall provide evidence that the non-U.S. institution and/or government officials are aware and supportive of the proposed investigation and will pursue funding for the investigation if selected by NASA. Such endorsements shall be submitted per the schedule in Section 1.5 and in compliance with the provisions of Sections 3.1 – 3.3, 4.2.1, and 4.2.7. Include these letters in Section L of the proposal. An example letter of endorsement is included at the end of this Appendix K.

Note within the constraints of the page limits:

Step-One proposals at minimum shall cover the following item(s).

1. **Description of endorsements planned at the submission of the Step-One proposal.**

Step-Two proposals at minimum shall cover the following item(s).

1. **Description of all endorsements**
2. **All letters of endorsements**
3. **All requirements described above**

F. SCIENCE/APPLICATIONS INVESTIGATION

1. Science/Applications Goals, Objectives, and Justification

   This section shall provide a detailed discussion of the planned scientific investigation to be conducted. This includes identifying the science question(s) to be addressed; the measurement approach and objectives; the underlying physics of the proposed measurements; scientific problem relevance to the Earth Science Enterprise and complementarity to EOS and other ESE approved flight programs; science measurement requirements (lifetime, orbit, resolution, accuracy, etc.); Baseline Science Mission and Minimum Science Mission; science team members and their experience and area of expertise relative to the science measurement objectives; science validation and correlative measurement plan; algorithm development plan; and data processing and distribution plan. The scientific/applications objectives and methodologies shall be consistent during the Step-One and Step-Two proposal processes.

   Establishing research priorities becomes a major challenge when priorities cross a number of different disciplines, each embracing a large set of scientific questions. The challenge facing the ESE is to balance competing demands in the face of limited resources and chart a program that addresses the most important and tractable scientific questions and allows optimal use of NASA's unique capabilities for global observation, data acquisition and analysis, and basic research. To this end, choices need to be made between many projects, all of which are important, timely, and ready to succeed. Most significant from a strategic perspective are the choices between different but equally promising candidate space flight missions or measurement systems.

   Thus, NASA’s selection of priorities involves both scientific needs and implementation realities. Scientific considerations are paramount and start the prioritization process. These considerations determine what science questions, and ultimately which missions and research projects shall be pursued. Purely scientific considerations are followed by considerations of science-related context (e.g., benefit to society, mandated programs), followed in turn by implementation considerations. The latter, such as technology readiness, tend to influence the order in which science projects are pursued and the final shape they may take. These practical considerations often result in some feedback and iteration of project selection.

The key research topics studied by NASA's Earth Science Enterprise fall largely into three categories: forcings, responses, and the processes that link the two and provide feedback mechanisms. This conceptual approach applies to all research areas of NASA's Earth Science program. The scientific strategy to address this complex problem can be laid out in five fundamental questions, each raising a wide range of cross-disciplinary science problems.

- *How is the global Earth system changing?*
- *What are the primary forcings of the Earth system?*
- *How does the Earth system respond to natural and human-induced changes?*
- *What are the consequences of change in the Earth system for human civilization?*
- *How well can we predict the changes to the Earth system that will take place in the future?*

While these five questions define a logical progression in the study of global change, each one covers a range of topics too broad to serve as a simple guide for program implementation. For this purpose, more specific research questions need to be formulated and prioritized. The ESSP Project is designed to both complement and extend the existing ESE flight program strategy. This third ESSP AO seeks to address the following Earth science research priorities and associated questions based on a logical progression of our current understanding (as listed in Section 2.2 of the ESSP AO).

Earth System Variability and Trends

- How are global precipitation, evaporation, and the cycling of water changing?

Primary Forcings of the Earth System

- What trends in atmospheric constituents and solar radiation are driving global climate?
- How is the Earth surface being transformed, and how can this information be used to predict future changes?

Earth System Responses and Feedback Processes

- What are the effects of clouds and surface hydrologic processes on climate change?
- How do ecosystems respond to and affect global environmental change and the carbon cycle?
- How can climate variations induce changes in the global ocean circulation?
- How do stratospheric trace constituents respond to change in climate and chemical composition?
- How is global sea level affected by climate change?
- What are the effects of regional pollution on the global atmosphere, and the effects of global chemical and climate changes on regional air quality?

NASA will consider scientifically compelling proposals based on other scientific questions, but proposers shall provide a clear and concise justification in the Step 1 proposal.

An explicit scientific justification of the proposed investigation shall be provided. This includes:

- defining the role of the proposed investigation in addressing key Earth science research objectives and scientific question(s) outlined in Section 2.0 of the ESSP AO,
- its applicability to current environmental issues,
- how it differs from or complements existing or approved spaceflight missions,
- documentation of the existing state of knowledge with respect to the problem to be addressed including existing models and observations,
- articulation of how the proposed mission addresses the stated problem, research objectives, or scientific questions in terms of measurement characteristics and instrumentation including the requisite in situ/correlative measurements necessary to provide an integrated observation strategy, and
- a definition of the mission characteristics, including specifics of the spatial and temporal sampling modes and precision and accuracy. In addition, a detailed Sensitivity Analysis shall be provided that describes how the proposed measurement set extends the state of Earth System Science knowledge in the problem area defined with respect to existing physical models, observational dataset(s), and/or observational trends. All references cited should be available from literature (i.e., commonly available journals and books) or easily accessible as preprints (i.e., accepted for publication). The impact of degradation of mission characteristics on the scientific objectives of the investigation shall also be described.

Plans and/or technology insertion roadmaps for transferring technologies to other missions, and/or to the private sector, including the non-aerospace sector are encouraged. The means by which NASA's Office of Earth Science plans to implement new technology is described in the *Office of Earth Science Integrated Technology Strategy* (http://www.earth.nasa.gov/visions/index.html) and the *NASA Technology Plan* (http://technologyplan.nasa.gov/).

2. Measurement Objectives and the Nature of the Investigation

Proposals shall cover the end-to-end investigation to answer the over-arching Earth system scientific/applications questions. The relationship between the proposed scientific objectives, the data to be returned, and the instrument payload to be used in carrying out the proposed investigation shall be unambiguous and clearly stated in the proposal. Any support activities including balloon, aircraft, and ground validation/calibration activities shall be described.

The proposal shall demonstrate that the proposed mission would acquire the necessary results within the life span of the mission. The mission shall not require an extension of the mission beyond the life proposed and costed in the proposal. Extended missions will not be considered as part of this AO.

Include also a discussion of any descope or reduced mission performance options. Discuss the impacts of these and the scientific/application resilience of the investigation.

3. Instrumentation

This section shall fully describe the proposed science instrumentation to be provided, including the criteria for its selection. The linkage between the required physical measurements and the proposed instrumentation shall be described in detail. In addition, an assessment of the technical maturity of all proposed instrumentation shall be provided. This Instrumentation Technical Maturity Matrix shall include the name of each major element, a description of the item, an assessment of its maturity level (according to the definitions in Appendix L, Figure L-1) and rationale for each maturity assessment given, including examples of heritage, exiting instruments, breadboards, and prototypes, if any. The format of the Instrumentation Technical Maturity Matrix shall be as shown in Appendix L, Figure L-2.

To quantitatively document how the proposed instrumentation permits key scientific problems to be addressed, a traceability analysis is required. The details of the mapping between scientific objectives and the measurements required to fulfill these objectives shall be provided, as well as the mapping between functional requirements and top-level engineering requirements. This analysis shall be presented as the Science Traceability Matrix, with individual scientific requirements mapping into functional requirements, which themselves map into higher order engineering requirements. The matrix format shown in Appendix L, Figure L-3 shall be used.

A description of the operational scenario/modes and an overall functional description and block diagram for all instrumentation shall be provided. Instrumentation concept, feasibility or definition studies already performed shall be summarized. Instrumentation performance requirements (resolution, sensitivity, and accuracy) shall be related to the proposed science measurement objectives for both the Baseline and Minimum Science Missions described above. A description of the technology/development risks and the plan to address them shall be included. A schedule for instrument development shall be provided. Provide the information in Table K-4 (can be preliminary for Step-One):

4. Anticipated Science/Applications Return

The relationship between the data products generated and the scientific/applications objectives shall be explicitly described, as shall the expected results. ESSP mission teams will be responsible for the measurements to be taken in the course of the mission, the data to be returned, the approach that will be taken in analyzing the data to achieve the scientific objectives of the investigation, the initial analysis of the data, its subsequent delivery to an appropriate data repository, the publication of scientific findings, and communication of results to the science community and public. The proposal shall provide a discussion of the scientific/applications products and how the science/applications products and data obtained will be used to fulfill the scientific objectives. This shall include a discussion of how the science/applications data will be

obtained, including a plan for delivery of the products, and the individuals responsible for the data delivery. This description shall identify the investigation to be performed, the quality of the data to be returned (resolution, coverage, pointing accuracy, measurement precision, etc.), and the quantity of data to be returned (bits, images, etc.).

Table K-4. Instrument Information.

Item	Value	Units
Sensor type		
Number of channels		
Size		
Mass with contingency		
Power with contingency (nominal, peak, duty cycle, standby)		
Data rate with contingency		
Mechanical, electrical, and thermal layouts		
Optical layout including field of view (if appropriate)		
Ground and on-orbit calibration scheme		
Pointing requirements (knowledge, control, and stability)		
Command and control requirements		
Flight software development plan (use of existing or commercial off the shelf software shall be identified)		

The plan for algorithm development shall be discussed. In addition, the data reduction and analysis plan, after the data have been delivered to the ground, shall be discussed, including the method and format of the data reduction, data calibration and validation, and preliminary analysis. The process by which data will be prepared for archiving and distribution shall be discussed, including a list of the specific data products and the individual team members responsible for the data products. The plan shall include a detailed schedule for the submission of raw and reduced data to the appropriate data archive in the proper formats, media, etc. Delivery of the data to the data archive shall take place in the shortest time possible.

In accordance with NASA policy, data from NASA funded missions shall be disseminated to the scientific community without restriction for a cost of no more than the cost of dissemination. ESSP teams are encouraged to propose innovative data management processes for data dissemination and wide data distribution processes. For data from a mission with significant U.S. private sector investment, innovative data management approaches will be considered. Data are to be released as soon as possible after a brief data validation period appropriate for the mission and the process shall be described. ESSP teams will be responsible for collecting the scientific, engineering, and ancillary information necessary to validate and calibrate the scientific data prior to

depositing it in the appropriate data repository. This repository shall conform to the guidelines outlined in Appendix I. The time that is required to complete this process shall be the minimum necessary to provide appropriate data to the scientific community and the general public and shall be described in the proposal. As part of the funded data analysis, archival and dissemination activities, mission teams shall include an appropriate period for data analysis independent of archiving activities.

5. Science/Applications Team

   A single Principal Investigator (PI) that will be responsible for the scientific integrity of the mission **shall** lead each ESSP mission investigation team. Co-Investigators may be from any category of U.S. or non-U.S. organization, including educational institutions; industry or nonprofit institutions; one of the NASA Centers, the Jet Propulsion Laboratory (JPL), other Federally-funded research and development centers, or other U. S. Government agencies; or foreign organizations. However, Co-Investigators shall have an identified role in the proposal, play a defined and necessary role in the investigation, and covered in the funding plan . Teams may be formed from any combination of these institutions. This mission team has full responsibility and authority to accomplish the mission.

   The capabilities and experience of all members of the proposed science team shall be described. In addition, the role of each science team member in the investigation shall be explicitly defined. Resumes or vitae of team members shall be included in an Appendix of the proposal. Any plans for producing an initial analysis of early mission data shall be described.

6. Plans to Resolve Open Science/Applications Investigation Issues

   Identify and discuss any unresolved issues. Include your planned approach and schedule for resolving these issues.

Note within the constraints of the page limits:

Step-One proposals at minimum shall cover the following item(s).

1. **Science/Applications Goals, Objectives, and Justification**
2. **Measurement Objectives and the Nature of the Investigation**
3. **Instrumentation**
4. **Anticipated Science/Applications Return**
5. **Science/Applications Team**
6. **Plans to Resolve Open Science/Applications Investigation Issues**

Step-Two proposals at minimum shall cover the following item(s).

1. **Science/Applications Goals, Objectives, and Justification**
2. **Measurement Objectives and the Nature of the Investigation**
3. **Instrumentation**
4. **Anticipated Science/Applications Return**
5. **Science/Applications Team**

6. Plans to Resolve Open Science/Applications Investigation Issues

G. TECHNICAL IMPLEMENTATION

The Technical Implementation section shall describe the method and procedures for investigation definition, design, development, integration, ground operations, and flight operations. Discuss all new technologies used for the investigation, including back-up plans with scheduled decision criteria. This section shall also detail the expected products and end items associated with each phase. Describe the capabilities and experience of all members of the proposed technical implementation team. Mission teams have the freedom to use their own processes, procedures, and methods. The use of innovative processes, techniques, and activities by mission teams in accomplishing their objectives is encouraged when cost, schedule, and technical improvements can be demonstrated. Discuss the benefits of such processes and products.

Address in your Step-One proposal the information identified in Table K-3 according to the page limits in Table K-1. If available, additional data can be supplied but is not required; however, the page limits still apply. Step-Two shall address all sections and mission design shall be addressed in detail. Remember, the more data supplied the more accurate the mission design analyzes will be.

1. Mission Design

   This section shall provide an overview of the mission, including mission design, mission design drivers, instrument accommodation, spacecraft, launch vehicle and services required, orbital parameters, ground systems communications approach, and mission operations plan

   Specific information shall be included that describes the unique requirements placed on these mission elements by the science/applications investigation. Proposals shall include linkage between required physical measurement and proposed mission approach. A "Mission Traceability Matrix" showing how the proposed mission design complies with the stated objectives, requirements, and constraints of the proposed investigation shall be provided. The format of the Mission Traceability Matrix shall be as shown in Appendix L, Figure L-4.

   The proposal shall describe the mission observing strategy and spacecraft performance required for obtaining the necessary data with the proposed instrumentation. Include the concept for operating the mission and the requirements for mission operations. Consider providing a preliminary mission timeline indicating periods of data acquisition, data downlink, eclipses, etc. Include the rationale for the selection of the launch option.

   The heritage and maturity of mission elements including, the spacecraft, ground systems, and mission design shall be addressed. The proposal shall describe the systems engineering approach including the integration and test approach, trade studies to be conducted, and the approach to flight assurance, including reliability and redundancy.

The rationale for the selection of launch vehicle shall be provided. If not NASA-provided, the prior demonstrated flight record and qualification history of the launch vehicle shall be provided. In addition, the proposal shall identify and discuss any innovative features of the mission design that minimize total mission costs.

In order to assess the mission design, Table K-5 (a) data shall be provided for Step-One. Step-Two proposals shall provide the data requested in Tables K-5 (a) and (b).

Table K-5. Mission Design Table
(a) Step-One Mission Design Table

Parameter	Value, units
Launch Vehicle Performance, kg	
Orbit Apogee Altitude, km	
Orbit Perigee Altitude, km	
Orbit Inclination, deg	
Orbit Node Time of Day for Sun Synchronous Orbits	
Parking Orbit Apogee Altitude, km (if applicable)	
Parking Orbit Perigee Altitude, km (if applicable)	
Parking Orbit Inclination, deg (if applicable)	
Launch Date, Launch Period, mm/dd/yy	
Mission Lifetime, days	
Instrument Mass, kg	
Instrument Required Pointing Accuracy, deg	
Instrument Required Pointing Knowledge, deg	
Instrument Average Data Rate, kbps	
Instrument Average Power, W	
Communications Ground Station Contacts per Day	
Communications downlink rate, mbps	
Spacecraft Dry Bus Mass, kg	
Spacecraft Propellant Mass, kg	
Launch Vehicle to Payload Adapter Mass, kg	
Launch Vehicle Margin, kg and %	
Spacecraft Bus Power, Watts	
Spacecraft Power Margin, Watts and %	

(b) Step-Two Mission Design Table

Parameter	Value, units	Contingency, units
Orbit Apogee Altitude, km		N/A
Orbit Perigee Altitude, km		N/A
Orbit Inclination, deg		N/A
Orbit Node Time of Day for Sun Synchronous Orbits		N/A
Parking Orbit Apogee Altitude, km (if applicable)		N/A
Parking Orbit Perigee Altitude, km (if applicable)		N/A
Parking Orbit Inclination, deg (if applicable)		N/A
Launch Date, mm/dd/yy		N/A
Mission Lifetime, days		N/A
Maximum Eclipse Period, minutes		N/A
Instrument Mass, kg		
Instrument Required Pointing Accuracy, deg		N/A
Instrument Required Pointing Knowledge, deg		N/A
Instrument Average Data Rate, kbps		
Instrument Average Power, W		
Spacecraft Dry Bus Mass, kg		
Spacecraft Dry Bus Mass by Subsystem		
Spacecraft Propellant Mass, kg		
Launch Vehicle Margin, kg and %		
Spacecraft Bus Power, Watts		
Spacecraft Bus Power by Subsystem, Watts		
Spacecraft Power Margin, Watts and %		

2. Instrument Implementation

This section shall describe the science/applications instrument (or instruments) for the investigation. Include a preliminary description of each instrument with a block diagram showing the instrument systems and their interfaces, along with a description of the estimated performance of the instrument. Provide a summary of the key margins, including the rationale for margin allocation. Identify those design margins that are driving costs.

The proposal shall indicate items that to be developed, as well as any existing instrumentation or design/flight heritage. An Instrumentation Technical Maturity Matrix (example shown in Appendix L, Figure L-2 showing the technical maturity of the instrument components, using the technical readiness levels (defined in Appendix L, Figure L-1) shall be included. Discuss the steps needed for space qualification of your instrument. Identify any innovative features incorporated to effect cost savings. Include where appropriate calibration plans and operational/control considerations.

3. Instrument Interface and Payload Integration

This section shall characterize the interface between the science instrumentation and the spacecraft. The planned process for physically and analytically integrating the science payload with the spacecraft shall be described. Along with a description of the payload layout and configuration, the accommodation of the science instruments by the spacecraft shall be addressed as follows:

- Instrument location constraints
- Mechanical/structural interface
- Field of view, alignment and pointing
- Baffling or other protection
- Thermal environment/temperature limits
- Commands
- Timing (clocks)
- Environmental sensitivities (electrical cleanliness, magnetic fields, contamination, etc.)

In order to assess the instrument characteristics, the following table of data shall be provided.

Table K-6. Instrument Characterization Table

Parameter	Value, units	Contingency, units
Mass		
Volumetric Envelope		
Attitude		
Fields of View		
Weight		
Power		
Thermal Limits		
Pointing		
Stability		
Command and Telemetry		
Data Collection Rate		
Data Storage		
Data Processing Onboard		
Data Processing On Ground		

The proposal shall discuss the sensitivity to or generation of contamination (e.g., electromagnetic interference, gaseous effluents, etc.), and the potential (if any) for significant instrument-generated jitter and momentum. Describe the planned process for physically and analytically integrating the instrument(s) with the flight system. Describe the testing strategy of the science/applications payload, before integration with the spacecraft.

4. Spacecraft

This section shall describe the spacecraft design approach, particularly as it relates to new versus existing hardware and redundant versus single-string hardware. It shall fully identify the spacecraft and describe its characteristics and requirements. A preliminary description of the spacecraft design with a block diagram showing the spacecraft subsystems and their interfaces shall be included, along with a description of the flight software and a summary of the estimated performance of the spacecraft. The flight heritage and/or rationale used to select the spacecraft and its subsystems, major assemblies, and interfaces shall be described. Indicate the standard or custom electrical and data interfaces planned, and the rationale for the choices. In addition, an assessment of the technical maturity of each subsystem and critical component shall be provided. This "Spacecraft Technical Maturity Matrix" shall define the technology readiness level (as defined in Appendix L, Figure L-1) of each item, along with a rationale for the assigned rating. The Spacecraft Technical Maturity Matrix is separate from the previously requested Instrumentation Technical Maturity Matrix and is counted as part of the proposal page limit. The format of the Spacecraft Technical Maturity Matrix shall be as shown in Appendix L, Figure L-2.

Subsystem characteristics and requirements shall be described to the greatest extent possible. Such characteristics include: mass, volume, and power requirements; pointing knowledge and accuracy; new developments needed; spaceflight qualification plan; and logistics support. Any design features incorporated to effect cost savings shall be identified. A summary of the resource elements of the spacecraft design concept, including key margins, shall be provided. The rationale for margin allocation shall also be provided. Those design margins that are driving costs shall be identified.

Plans for all phases of software development, including the use of existing (including "commercial off-the-shelf") software, shall be described. The method planned for development and validation of flight software shall be addressed.

The method for resolving any major open spacecraft issues, major systems trades, and technology development planned in Mission Definition and Preliminary Design shall be addressed. A preliminary schedule for the spacecraft development shall be included.

In order to assess the spacecraft subsystem characteristics, the following table of data shall be provided.

Table K-7. Spacecraft Characteristics Table

Spacecraft bus	Value, units
Propulsion	
Estimated delta-V budget	
Propulsion type(s) (monoprop, bi-prop, dual-mode, solar electric, etc.) and associated propellant(s)/oxidizer(s)	
Propellant mixture ratio (if bi-prop)	
Specific impulse of each propulsion mode	
Attitude Control	
Control method (3-axis, spinner, gravity gradient, etc.). For spin stabilized spacecraft provide spin rate and axis in terms of spacecraft body coordinate frame.	
Control reference (solar, inertial, Earth-nadir, Earth-limb, etc.)	
Attitude control capability	
Attitude knowledge limit	
Agility requirements (maneuvers, scanning, etc.)	
Articulation (1- or 2 -axis solar arrays, antennas, gimbals, etc.)	
Attitude knowledge processing (*e.g.*, real-time versus post-processing, spaceborne versus ground)	
Sensor and actuator information (precision/errors, torque, momentum storage capabilities, etc.)	
Command & Data Handling	
Spacecraft housekeeping data rate	
Data storage unit type and capacity, name and Mbits	
Maximum storage record rate	
Maximum storage playback rate	

Spacecraft bus	Value, units
Power	
Definition of each spacecraft subsystem operational mode over all science phases. Provide power demand for each operational mode.	
Type of array structure (rigid, flexible, body mounted)	
Solar array axes of rotation (vector projected in spacecraft coordinates)	
Array size	
Solar cell type	
Solar cell efficiency	
Expected power generation at Beginning of Life (BOL) and End of Life (EOL)	
Worst case sun incidence angle to solar panels during science mission	
Battery type	
Battery storage capacity	
Worst case battery Depth of Discharge (DOD)	
Spacecraft bus voltage	

For partial mission proposals, provide the appropriate information above that is related to the proposed investigation's requirements on and interfaces with the host spacecraft.

5. Launch Service

The proposal shall discuss the launch option selection, the range of acceptable launch options, and orbit parameters. If proposing a partial mission (an instrument on another, host spacecraft), describe the plans for the host mission. Include information on the launch option margins and reserves (volume, mass, etc.).

In order to assess the launch services requirements, the following table of data shall be provided.

Table K-8. Required Launch Services Table

Launch Vehicle	Value, units
Launch Vehicle Performance, kg	
Shroud Volume, m^2	
Launch Site, name	
Injection Inclination Error, Degrees	
Injection Line of Nodes Error, Degrees	
Injection Altitude Error, km	

6. Manufacturing, Integration and Test

   This section shall describe the manufacturing strategy to produce and verify the hardware/software necessary to accomplish the mission. It shall include a description of the main processes/procedures planned in the fabrication of flight hardware and software development; use of production personnel resources; incorporation of new technology/materials; and the preliminary test and verification program.

   The approach, techniques, and facilities planned for manufacturing, integration, test and verification, and launch operations phases, consistent with the proposed schedule and cost, shall be described. A preliminary schedule for manufacturing, integration, and test activities shall be included. A description of the planned end items, including engineering and qualification hardware, shall be included. The use of any existing test facilities and processes shall be described.

7. Mission Operations, Ground, and Data System

   This section shall discuss mission operations and the ground operations support required for the proposed investigation. The planned approach for managing mission operations and all flight operations support, including mission planning, shall be discussed. The proposal shall describe the approach to the development of the ground data system, including the use, if any, of existing facilities, including Government facilities. Include a block diagram of the Ground Data System (GDS) showing the end-to-end concept (acquisition through archiving) for operations and data flow to the subsystem level. Describe the use of standards, such as Consultative Committee for Space Data Systems (CCSDS) recommendations or commercial standards, on the space/ground communications link. Describe the software design heritage and software development approach and its relationship to the flight system software development. Discuss the proposed communications (or active sensing) frequency bands, and identify any issues for obtaining spectrum allocation license(s).

   This section shall describe the planned approach for managing mission operations and all flight operations support, including mission planning. A description of the operational phase of the mission shall be included. Operational constraints, viewing requirements, and pointing requirements shall also be identified. Describe any special communications,

computer security, tracking, or near real-time ground support requirements, and indicate any special equipment or skills required of ground personnel.

The acquisition of data and the processing of that data both onboard the spacecraft and on the ground shall be described. The plan for processing the data after it has been delivered to the ground shall be discussed, including the method and format of the data reduction, data validation, and preliminary analysis. The process by which data will be prepared for archiving shall be discussed and the plan shall include a detailed schedule for the submission of data to the public domain in the proper formats, media, etc. Delivery of the data to the public domain shall take place in the shortest time possible.

In order to assess the mission operations and ground data systems, the following table of data shall be provided.

Table K-9. Mission Operations and Ground Data Systems Table

Down link Information	Value, units
Number of Data Dumps per Day	
Downlink Frequency Band, GHz	
Telemetry Data Rate(s), bps	
S/C Transmitting Antenna Type(s) and Gain(s), name and DBi	
Ground Station Selection(s), name	
Geographic locations of Ground Station(s) if not existing within STDN network, latitude & longitude	
Downlink Receiving Antenna Gain, DBi	
Bit Error Rate	
Downlink Modulation Format (e.g., PCM/PM/Bi-Ù, PCM/PSK/PM, BPSK, QPSK, etc.), name	
Error Detecting-Correcting Coding (e.g., convolutional, Reed-Solomon, concatenated, etc.), name	
Transmitting Power Amplifier Output, Watts	

Uplink Information	Value, units
Number of Uplinks per Day	
Uplink Frequency Band, GHz	
Telecommand Data Rate, bps	
S/C Receiving Antenna Type(s) and Gain(s), name and DBi	

Specific features incorporated into the flight and ground system design that lead to low-cost operation shall be identified. The use of any existing mission operations facilities and processes shall be described, as well as any new facilities required to meet mission objectives.

Mission teams may use non-NASA or NASA navigation, tracking, control, communications, and other services. Information on space communications capabilities and costing is given in the Ground Data Systems and Mission Operations and Data Analysis document available in the ESSP Project Library. Address in your proposal spectrum allocation and licensing plans and issues. ISS payloads shall use the ISS communications systems that are provided at no cost and described in documents referenced in the ISS ESSP Research Opportunities document in the ESSP Project Library.

8. Plans to Resolve Open Technical Implementation Issues

This section shall describe the means by which the mission definition and preliminary design study will be performed. This section shall identify the key mission tradeoffs and options to be investigated during the Step-Two process and shall identify those issues, technologies, and decision points critical to the mission success. Identify and discuss any unresolved issues and potential risk areas to the proposed investigation. Identify your approach and schedule for resolving these issues and mitigating these risks. For example:

- NASA recognizes that teaming arrangements to implement the investigation may not be complete at the time of the proposal. If your teaming arrangements are not complete, demonstrate in your proposal that there are multiple implementation approaches for the spacecraft, launch vehicle, communications, and ground systems that will allow the successful implementation of the investigation.
- NASA seeks innovative missions but because of the short definition and development time, significant technology development may not be possible although technology infusion that enhances performance and reduces costs of the mission is encouraged. Investigations dependent on new technology, technology development, or technology enhancement shall identify the technology(s) along with risks involved and alternative approaches to resolve issues by completion of the Step-Two process. If necessary, identify a reasonable back-up approach that will assure the success of the investigation.

Note within the constraints of the page limits:

Step-One proposals at minimum shall cover the following item(s).

1. **Mission Design**
2. **Instrument Implementation**
3. **Launch Service**

Step-Two proposals at minimum shall cover the following item(s).

1. **Mission Design**
2. **Instrument Implementation**

3. **Instrument Interface and Payload Integration**
4. **Spacecraft**
5. **Launch Service**
6. **Manufacturing, Integration and Test**
7. **Mission Operations, Ground and Data System**
8. **Plans to Resolve Open Technical Implementation Issues**

H. MANAGEMENT

The Management section shall summarize the management approach and the facilities and equipment required. This section sets forth the investigator's approach for managing the work, the recognition of essential management functions, and the overall integration of these functions. This section shall specifically discuss the decision-making process to be used by the team, focusing particularly on the roles, responsibilities and authority of the Principal Investigator (PI) and Project Manager (PM) in that process. The Management section shall provide insight into the organizations proposed for the work, including the internal operations and lines of authority, together with internal interfaces and relationships with NASA, team members, major subcontractors, and associated investigators. It also identifies the institutional commitment of all team members, and the institutional roles and responsibilities. The use of innovative processes, techniques, and activities by mission teams in accomplishing their objectives is encouraged when cost, schedule, and technical improvements can be demonstrated. Given the relatively short development cycle for small missions such as ESSP, proactive management practices in identifying risks and technical issues and addressing them in a timely fashion is key to the team's success. The evaluation teams will pay specific attention to this aspect of proposals.

The PI is expected to be in charge of the proposed investigation, with full responsibility for its scientific integrity. The PI is responsible for assembling a team to propose and implement the investigation. Proposers may obtain services from any source. Please note that the level of detail required in the proposal is the same, independent of which organizations are part of the proposed mission team. Do not assume that contributed or NASA Center elements need not be explained. The PI is accountable to NASA for the scientific success of the investigation. Therefore, the PI shall be prepared to recommend mission termination if, in his/her judgment, the successful achievement of established science/applications objectives, as defined in the proposal, is no longer likely within the committed cost and schedule reserves.

Each selected investigation shall have a named Project Manager (PM) who reports to the PI and will oversee the technical implementation of the investigation. The role, qualifications, and experience of the PM shall be adequate to ensure that the technical and managerial needs of the investigation will be met. The PI can assume the PM responsibilities only if he/she can provide information indicating direct and relevant previous experience and can commit a large percentage of time during definition and development phases.

1. Management Processes and Plans

This section shall summarize the investigator's proposed management approach, tools and processes. Proposals shall encompass all aspects of the investigation from the initial studies through delivery of the data to the appropriate data repository and their analysis. NPG 7120.5A, *Management of Major System Programs and Requirements,* delineates activities, milestones, and products typically associated with each of the phases and may be used as a reference in defining a team's mission approach. This document is included in the ESSP Project Library (see Appendix B). Mission teams have the freedom to use their own processes, procedures, and methods, and the use of innovative processes is encouraged when cost, schedule, technical improvements, and reliability can be demonstrated.

Partial mission proposals shall specifically address how the mission team will interrelate with the host organization, organizationally and managerially. This section shall also describe the proposed methods of hardware and software acquisition. Specifically, partial mission and hardware and software acquisition shall include the following, as applicable:

- Describe the status of the commitment from the spacecraft builder/owner or sponsoring organization to fly the proposed instrument or conduct the proposed investigation.
- Capabilities that each member organization brings to the team, as well as previous experience with similar systems and equipment.
- Management processes which the mission team proposes to:
  - develop and maintain the hardware and software requirements and specifications;
  - manage and control development progress;
  - manage and conduct technology development;
  - manage and conduct design;
  - manage, review, and control changes to hardware/software, documentation, etc.;
  - manage and conduct mission systems engineering and integration;
  - manage and conduct procurement, including make or buy decisions, subcontract management, etc.;
  - manage, control, and allocate resources, including reserves;
  - manage and conduct the testing and verification programs, including final checkout and calibration;
  - manage and conduct launch and mission operations;
  - manage and conduct data reduction and distribution;
  - coordinate with team members and document agreements;
  - provide NASA with insight; and
  - report progress to NASA.

- The specific decision-making process regarding all aspects of the mission, including mission descoping and distribution of reserves, and the individual with ultimate decision-making authority in such cases.
- Availability of proposed personnel on the team to successfully administer the mission contract and subcontracts and technically monitor the implementation.
- A document tree that describes key proposed documentation, including development schedule and current status of each document.

The team shall propose performance metrics that will be incorporated into a successful team's contract. Violation of the agreed upon metrics may be cause for termination. The mission team shall develop a Work Breakdown Structure (WBS) that best fits its organizational approach and mission design concept. Successful innovative management approaches will be examined by Office of Earth Science for use within the Earth science/applications program.

NASA intends to allow the Principal Investigator and his/her team to use their own management processes, procedures, and methods to the fullest extent possible. However, to ensure mission success, there will be appropriate Government oversight and insight. Mission teams shall define the management, review and reporting approach and management tools for tracking cost, schedule and risk best suited for their particular teaming arrangement. Each team shall have a safety reliability and quality assurance program. These approaches shall be commensurate with the investigation's implementation approach, while retaining a simple and effective management structure necessary to assure the adequate control of development within the cost and schedule constraints. NASA will require the following reviews:

- System Requirements Review
- Preliminary Design Review
- Mission Design Review
- Confirmation Readiness Review
- Mission Confirmation Review
- Critical Design Review
- Pre-Environmental Review
- Pre-Ship/Operational Readiness Review
- Mission Readiness Review
- Flight Readiness Review

Additional Shuttle and ISS required safety reviews are described in the ISS ESSP Research Opportunities document in the ESSP Project Library.

The use of innovative processes, techniques, and activities by mission teams in accomplishing their objectives is encouraged; however, they shall be employed only when cost, schedule, or technical improvements can be demonstrated and specific enabling assumptions are identified. In addition, each team shall identify management processes and tools that may be useful to NASA in the management of its programs and projects.

2. Schedule

A project schedule to meet the proposed launch date shall be provided covering all phases of the investigation and identifying major milestones. The schedule shall include, as a minimum, proposed major project review dates including NASA required reviews; instrument development; spacecraft development; instrument-to-spacecraft integration and test; launch vehicle integration; and mission operations, algorithm development and data analysis. Schedule reserve shall be clearly identified.

3. Team Organization, Structure, and Experience

The roles, responsibilities, time commitment, experience of all key personnel, and institutional commitments shall be described in this section, with particular emphasis placed on the responsibilities assigned to the PI, the Project Manager and other key personnel. The proposal shall address any unique capabilities that each team member organization brings to the team, as well as previous experience with similar systems and equipment. In addition, information shall be provided which indicates what percentage of time will be devoted to the mission, the duration of service, and how changes in personnel will be accomplished. (Note: The experience of the PI and science team members does not need to be included in this section since it would have been addressed in the Science section.)

- PRINCIPAL INVESTIGATOR - The role(s), responsibilities, and time commitment of the single Principal Investigator shall be discussed. Provide a reference point of contact including address and telephone number.
- PROJECT MANAGER - The role, responsibilities, time commitment, credentials and experience of the Project Manager shall be provided. The Project Manger shall report directly to the Principal Investigator. In addition, the Project Manager shall be named in the Step-Two Proposal. Provide a reference point of contact including address and telephone number.
- OTHER KEY PERSONNEL - The roles, responsibilities, time commitments, and experience of the Co-Investigators and other key personnel in the investigation shall be described.

The management organizational structure of the investigation team shall be described in the proposal. The proposal shall identify the teaming approach to be used and describe the responsibilities of each team member and their contributions to the investigation. The work of these individuals and institutions shall be accounted for in the cost elements breakdowns provided in the Cost section.

Of special interest is the organizational approach and plan for efficient and effective management of the multi-organizational interfaces between cooperating partners and team members. Particular emphasis shall be placed on the organizational relationship between the PI and the PM. The capability of the team to respond quickly and effectively

to problems and inter-organizational conflicts shall be demonstrated. Proposed lines of communication and authority shall be demonstrated.

The contractual/financial responsibilities and relationships of all team partners, including contributions, shall be described. The mechanisms (contracts, subcontracts, cooperative agreements, memoranda of agreement, etc.) by which organizations commit to participate as partners on a proposing team shall be clearly identified. Include a description of incentives and fee strategy, where appropriate, and their rationale. The proposal letters of endorsements shall include the signature of an official from each organization represented on the team or contributing to the investigation who is authorized to commit that organization to the proposed investigation. Failure to include any such authorization may be grounds for rejection of the proposal. Non-U.S. organizations and funding sources participating as team partners shall also meet this requirement. Information on procurement of long lead items and proposed major and critical subcontracts, including procurement activities of all team partners, shall be provided. The information shall consist of, at a minimum, name of the item, scope of the work to be performed, name and location of supplier or subcontractor, proposed award schedule, deliverable items and delivery schedule, proposed performance assurance requirements, and contingency plans if a supplier or subcontractor fails to perform. Describe the relationships and controls you will exercise over suppliers and subcontractors from both cost and schedule standpoints.

The experience (successes *and* failures) of team partners in managing projects of similar scope, including cost and schedule performance within the last ten years shall be discussed.

4. Risk Management

This section shall describe the approach to, and plans for, risk management to be taken by the team, both in the overall mission design and in the individual systems and subsystems. Particular emphasis shall be placed on describing how the various elements of risk will be managed to ensure successful accomplishment of the mission within cost and schedule constraints. Included in this discussion of risk management shall be risk mitigation plans for any new technologies and the need for any long-lead items that need to be placed on a contract before the start of the development phase to ensure timely delivery. In addition, any manufacturing, test, or other facilities needed to ensure successful completion of the proposed investigation shall be identified. In the event risks cannot be managed successfully and mission objectives shall be revised toward the Minimum Science Mission, this section shall describe the descope options available to the team, their phasing, and their effect on mission performance relative to the previously defined Baseline Science Mission. If the proposed Baseline and Minimum Science Missions are equivalent, proposers shall clearly articulate the rationale for this decision and identify viable contingency options (e.g., additional reserves, etc.). This section shall identify the latest possible dates at which descope options may be implemented and the procedure by which they would be accomplished.

5. Mission Assurance and Safety

   This section shall describe the process by which mission success is assured and achieved. This section shall describe mission assurance plans to ensure product quality, including specific plans for reviews, identification of trade studies, plans to incorporate new technology, problem/failure resolution, inspections, quality assurance, reliability, parts selection and control, and software validation activities compatible with industry best practices, ISO 9000 quality standards, American National Standard, "Quality Systems - Model for Quality Assurance in Design, Development, Production, Installation, and Servicing," ANSI/ASQC Q9001-1994, and the Mission Assurance Guidelines and Requirements in Appendix H. A table similar to that shown in Appendix L, Figure L-5 shall be used to illustrate compatibility of the proposer's own mission assurance processes with the Mission Assurance Guidelines and Requirements.

   In addition, this section shall describe the process by which safety standards are met and hazards mitigated. The mission team member responsible for implementing the system safety program for the proposed mission shall be identified. Past experiences of this mission team member in implementing system safety program from previous missions shall be described. This section shall also describe all safety plans and practices to be used in mission development. These plans and practices shall be compliant with the Flight and Ground Safety Requirements in Appendix J. This section shall also address the mission's compliance with NASA Safety Standard (NSS) 1740.14, "Guidelines and Assessment Procedures for Limiting Orbital Debris", which can be found in the ESSP Project Library (see Appendix B).

6. Facilities and Equipment

   All major facilities, laboratory equipment, and ground -support equipment (GSE) (including those of the team's proposed contractors and those of NASA and other U.S. Government agencies) essential to the mission in terms of its system and subsystems shall be indicated, distinguishing insofar as possible between those already in existence and those that will be developed in order to execute the investigation. The outline of new facilities and equipment shall also indicate the lead-time involved and the planned schedule for construction, modification, and/or acquisition of the facilities. The proposal shall also include documented availability of proposed assets.

7. Plans to Resolve Open Management Issues

   Identify and discuss any unresolved issues. Include <u>your planned approach</u> and schedule for resolving these issues.

<u>Note within the constraints of the page limits:</u>
Step-One proposals at minimum shall cover the following item(s).

1. **Management Processes and Plans**
2. **Schedule**

Step-Two proposals at minimum shall cover the following item(s).

1. **Management Processes and Plans**
2. **Schedule**
3. **Team Organization, Structure, and Experience**
4. **Risk Management**
5. **Mission Assurance and Safety**
6. **Facilities and Equipment**
7. **Plans to Resolve Open Management Issues**

I. COST AND COST ESTIMATING METHODOLOGY

Outside contributions to the mission are encouraged but are not required and there are no limits on the extent of those contributions. Contributions can be of cash, property or services on a no-exchange-of-NASA-funds basis. NASA civil service or NASA contractor resources may not be contributed unless separately funded by a complementary effort. NASA Center and NASA contractor participation **shall** be on a full-cost accounting basis.

Appendix L, Figure L-10 gives the NASA inflation index for calculating real year dollars.

For Step-One, this section shall summarize the total mission cost and cost estimating methodology including a discussion of any contributions. These costs are not intended to be detailed bottoms-up estimates but are a PI's best estimate of the expected cost of the elements in the table, and will be used in the evaluation process to determine cost risk as well as NASA's funding requirements. This estimate is not binding and may be adjusted in the Step-Two proposal. Cost is not an explicit part of the evaluation, and cost and cost estimating details are not required. However, NASA will estimate the cost of the mission in order to assess the risk of exceeding the ESE Mission Cost ceiling. NASA reserves the right to recommend a mix of larger and smaller missions proceed to Step-Two for programmatic reasons.

For Step-Two proposals: The expected NASA Mission Cost (NMC) and Total Mission Life Cycle Cost (TMLCC) in real year dollars shall be provided as indicated in the table below. Provide the cost and cost estimating details in a separate volume as described later in this Appendix.

Table K-10. Total Mission Life Cycle Cost (Real Year Dollars)

Cost Element	FY2001	FY2002	FY2003	FY2004	FY2005	Total
Mission Development:						
Proj. Mgmt/Misn. Analysis/Sys. Eng.						
Instrument A						
Instrument B						
Instrument …						
Subtotal - Instruments						
Spacecraft bus						
Science Team Support						
Ground Data System Development						
Education (1)						
Mission Operations Development Activities						
Integration, Assembly and Test						
Instrument Reserves						
Spacecraft Reserves						
IA&T Reserves						
Other Reserves						
Subtotal Reserves						
Total Mission Development						
Launch and Mission Operations						
Payload Integration to Launch Vehicle						
Mission Operations and Data Acquisition						
Data Analysis, Archival, and Dissemination						
Launch and Mission Operations Reserves						
Total Launch and Mission Operations						
Launch Vehicle and Services						
Total NASA Cost						
Contributions (2)						
1)						
2)						
…						
Total Contributions						
Total Mission Cost =						

(1) Education costs that are not included within other cost elements

(2) Specify each item on a separate line, identifying Contributor and what is being contributed

Note within the constraints of the page limits:

Step-One proposals at minimum shall cover the following item(s).

1. **Summarize the total mission cost and cost estimating methodology (Table K-10) including a discussion of any contributions**

Step-Two proposals at minimum shall cover the following item(s).

1. **Summarize the total mission cost and cost estimating methodology including a discussion of any contributions**
2. **Complete total mission cost table above (must be consistent with Appendix K, Section M Cost and Cost Estimating Details).**

J. EDUCATION

Necessary elements to be described in the Education plan include:

1. Rationale - Define the educational need the plan will meet. Identify the ESE science, applications, technology, or educational thematic element(s) being addressed. What are the interesting science questions that lie behind the project? Why are they interesting? What can be said about the connection of this work to societal needs?

2. Goals - Define the project goals and objectives. What are three to five basic "take-home messages"? What are the anticipated impact and outcomes? How do they contribute to the NASA's Earth Science Research Priorities described in Section 4.0 of NASA's Earth Science Enterprise Research Strategy 2000-2010 (Appendix A)? How will successful activities be sustained beyond the project duration and an on-going NASA investment?

3. Audience - Clearly define the target audience. Do primary and secondary audiences exist? What is known about the audience's learning or operating levels and styles? What does the audience know about the topic? What misconceptions might they have about the topic that might influence the learning or communication outcomes? Estimate the size of the target audience.

4. Activity - Thoroughly describe the proposed project. Describe how the project will be accomplished and the goals achieved. Include a timeline of the developmental period.

5. Dissemination - Describe how the activity or project will be broadly disseminated. Dissemination involves the marketing or announcing the activity, as well as developing the mechanisms to ensure that the intended audience will use the activity.

6. Evaluation - Describe how the project will be evaluated. Formative: What procedures will be used during the developmental phase of the project to assure a good product when it is completed? Who will do this work? Summative: How will it be determined that the educational goals have been achieved? Describe the means by which the impact of the project on the target audience will be examined? Who will do the evaluation?

7. Management - Identify and describe the personnel who will be involved in the development and production of the activity. What staff, advisors or external partnerships will be required? How is management of the educational activities configured in the

overall mission project management? Provide staffing details for all elements of the education plan.

8. Budget – Provide appropriate details on cost. What potential support from non-NASA sources exists? If so, what might these be and to what extent?

K. OTHER OPPORTUNITIES

1. Small, Small Disadvantaged, and Small Veteran-Owned Business, and Minority Institution Involvement

   This section shall provide a summary for the subcontracting plans for Small Disadvantaged, Women-Owned, and Veteran-Owned Small Businesses, and Minority Institutions involvement in the implementation of the investigation. The subcontracting approach shall be discussed and shall state subcontracting goals for small disadvantaged businesses, women-owned small businesses, veteran-owned small businesses, Historically Black Colleges and Universities, and Other Minority Universities.

   The proposing institution(s) shall agree to use their best efforts to assist NASA in achieving its goal for the participation of small disadvantaged businesses, women-owned small businesses, veteran-owned small businesses, Historically Black Colleges and Universities (HBCUs), and Other Minority Universities (OMUs) including Hispanic serving institutions and Tribal colleges and Universities in NASA procurements. Investment in these organizations reflects NASA's commitment to increase the participation of minority concerns in the aerospace community and is viewed as an investment in our Nation's future. Proposals shall recognize this requirement and shall discuss the intent to include small disadvantaged businesses and minority institutions.

   NASA contracts resulting from this solicitation which offer subcontracting possibilities, exceed $500,000, and are with entities other than small business concerns, will contain the clause at FAR 52.219-9. Offerors who are selected under the Step-Two Process under this AO, and who meet the foregoing conditions, will be required to negotiate appropriate subcontracting plans. A proposed subcontracting plan shall be provided in this section and will be evaluated as part of the Step-Two Process.

   The institutions eligible to be considered as Minority Institutions for the purposes described in this section are Historically Black Colleges and Universities (HBCUs) and Other Minority Universities (OMIs) as defined and certified by the Department of Education. A list of U.S. accredited post secondary minority institutions can be found at the Internet address http://www.ed.gov/offices/OCR/99minin.html .

2. Commercial Opportunities

   U.S. economic and technical competitiveness achieved through partnerships between pubic sector programs and the private sectors are important to the U.S. Also, many social benefits are derived from a strong U.S. economy. Therefore, proposals to enhance

commercialization opportunities are encouraged. Discuss in this section the nature of the commercial opportunity(ies) including a description of the U.S. company(ies) involved, the nature of the commercial involvement (for example, launch services, instrument, other product or service), and the market to be addressed. The social benefits and enhanced U.S. economic and technical competitiveness achieved through partnerships between the public sector programs and the private sector shall also be discussed. If the commercial opportunity involves use of data that will be acquired by the mission, any data rights required by the private sector partner shall also be defined (see section 3.2.3). Specify any specific examples of commercialization.

3. Plans to Resolve Open Other Opportunity Issues

   Identify and discuss any unresolved issues. Include your planned approach and schedule for resolving these issues.

Note within the constraints of the page limits:
Step-Two proposals at minimum shall cover the following item(s).

1. Educational
2. Small, Small Disadvantaged, Woman- and Veteran-Owned Small Businesses, and Minority Institution Involvement
3. Commercial Opportunities

L. APPENDICES

The following additional information is required to be supplied with the proposal as Appendices and, as such, will not be counted within the specified page limit.

1. Resumes. Provide resumes or curriculum vitae for all named team members identified in the proposal and on form Section B – Investigation Summary Form II. Resumes or curriculum vitae shall be no longer than one page in length.

2. Statement of Work (SOW) and Funding Information: For investigations managed from non-Government institutions, provide a SOW. For investigations managed from Government institutions, provide a SOW as if the institution were non-Government. The SOW shall include general task statements for Phases Mission Definition and Design, Mission Detailed Design, Mission Development and Launch, and Mission Operations and Data Analysis, Archival and Dissemination for ESSP Investigations, and performance metrics. All SOWs shall include the following, as a minimum: Scope of Work, Deliverables (including science/applications data), and Government Responsibilities (as applicable). SOWs need not be more than a few pages in length. Funding information and documentation shall be provided that identifies how funds are to be allocated among the organizations supporting the investigation. Funding documents shall be provided that are necessary to allocate the correct amount of funds to each organization supporting the investigation.

3. Certifications: The following certifications shall be provided with the proposal.

a) Civil Rights Certification form or NASA Form 1206, Assurance of Compliance with the National Aeronautics and Space Administration Regulations Pursuant to Nondiscrimination in Federally Assisted Programs (see Appendix Q).
b) Certification Regarding Lobbying (see Appendix P).
c) Certification Regarding Debarment, Suspension, and Other Responsibility Matters Primary Covered Transactions (see Appendix O).

Certification originals shall be provided with the original proposal. Copies of all certification shall be provided in all proposal copies.

4. Preliminary Mission Definition and Requirements Agreement. A draft Mission Definition and Requirements Agreement shall be provided. An example of a Mission Definition and Requirements Agreement is provided as Appendix R.

5. Draft Incentive Plan. A draft Incentive Plan shall be included with the Step-Two Proposal. This Incentive Plan shall outline contractual incentive features for all major team members. Incentive Plans shall include both performance and cost incentives, as appropriate.

6. Relevant Experience and Past Performance. Relevant experience and past performance (successes and failures) of the major team partners in meeting cost and schedule constraints in similar projects within the last ten years shall be discussed. A description of each project, its relevance to the proposed investigation, cost and schedule performance, and points of contact (including addresses and phone numbers), shall be provided.

7. Draft International Agreement(s). Draft International Agreement(s) are required for all non-domestic partners in the investigation. Elements to be included in the International Agreement can be found in Appendix F.

8. NASA Principal Investigator Proposing Teams. Proposals submitted by NASA employees as Principal Investigators shall contain the following information concerning the process by which non-Government participants were included in the proposal. The proposal shall (i) indicate that the supplies or services or the proposed non-Government participant(s) are available under an existing NASA contract; (ii) make it clear that the capabilities, products, or services of these participant(s) are sufficiently unique to justify a sole source acquisition; or (iii) describe the open process that was used for selecting proposed team members. While a formal solicitation is not required, the process cited in (iii) above shall include at least the following competitive aspects: notice of the opportunity to participate to potential sources; submissions from and/or discussions with potential sources; and objective criteria for selecting team members among interested sources. The proposal shall address how the selection of the proposed team members followed the objective criteria and is reasonable from both a technical and cost standpoint. The proposal shall also include a representation that the Principal Investigator has examined his/her

financial interests in or concerning the proposed team members and has determined that no personal conflict of interest exists. The proposal shall provide a certification by a NASA official superior to the Principal Investigator verifying the process for selecting contractors as proposed team members, including the absence of conflicts of interest.

9. Contractual Requirements. In order to expedite mission contract awards, proposers are required to propose mission contract terms, conditions and deliverables as defined below.

   Each proposer shall submit a list of contract deliverables for Mission Definition and Preliminary Design, and Phases Mission Detailed Design, Mission Development and Launch, and Mission Operations and Data Analysis, Archival, and Dissemination option (see Appendix S). Example contracts including deliverable lists (Section B.1 of the contract) for current ESSP missions are available in the ESSP Project Library (see Appendix B). Submitted contract deliverable lists shall be consistent with the format of these referenced examples.

   Proposers shall review the generic contract terms and conditions for educational institutions or commercial organizations (whichever is appropriate) in the ESSP Project Library (see Appendix B). Proposers shall specifically identify any exceptions and/or proposed changes to the contract terms and conditions (i.e., clauses) contained within the appropriate contract document. If no exceptions are taken, a statement to that effect shall be included. All proposed contractual documentation, if accepted by NASA, shall be considered executable upon selection. If no exceptions are taken, the sample generic contractual documents will be used as the basis for selected mission contract formulation. NASA reserves the right to negotiate all contract terms and conditions following mission selection.

The following information may be provided.

1. References List: Proposals may provide, as an appendix, a list of reference documents and materials used in the proposal. The documents and materials themselves cannot be submitted, except as a part of the proposal, unless the reference is in publication and therefore not generally available.

2. Acronyms List: Proposals may provide, as an appendix, a list of acronyms used in the proposal. Acronym use should be kept to a minimum in the proposal.

NO OTHER APPENDICES ARE PERMITTED.

Note:
Step-One proposals at minimum shall cover the following item.
1. Resumes

Step-Two proposals at minimum shall cover the following items

1. **Resumes**
2. **Statement of Work (SOW) and Funding Information**
3. **Certifications**
4. **Preliminary Mission Definition and Requirements Agreement**
5. **Draft Incentive Plan**
6. **Relevant Experience and Past Performance**
7. **Draft International Agreement(s) (if applicable)**
8. **NASA Principal Investigator Proposing Teams (if applicable)**
9. **Contractual Requirements**

M. COST AND COST ESTIMATING DETAILS

This section is only required for Step-Two Proposals and shall be placed in a separate volume from the rest of the proposal. See Table K-1 and Table K-2 for additional information. This section shall be consistent with the material described in Section I of this Appendix.

1. Basis of Cost Estimate

   The proposals shall include the Total Mission Life Cycle Cost (in real year dollars), which includes the NASA Earth Science Enterprise Cost cap, the NASA Launch Cost, and all contributed costs. The Total Mission Life Cycle Cost includes but is not limited to the following:

   - Mission conceptual study, definition and development of all flight and ground hardware and software, and operations of the mission
   - Non-satellite measurements necessary for calibration or validation of observations
   - Other mission support
   - Development, operation, refinement, maintenance, documentation, and publication of all required algorithms to accomplish the mission
   - Processing, archiving, distribution, maintenance, documentation, and information management of all mission derived data products to permit community-wide access
   - Publication of results in refereed science literature
   - Delivery to NASA, at mission end, all data supporting information and available results
   - Cost of the education requirements
   - Projects reserves
   - Acquisition of launch services and launch (identified separately)

   These costs shall be consistent with the project requirements described in Sections 3, 4, and 5 of the AO. The amount to be costed in each fiscal year shall be identified by providing the data in Appendix L, Figures L-6 through 9. The top portion of Appendix L, Figure L-7 requests cost data relative to the NASA ESE Cost. The lower portion addresses contributions. Appendix L, Figure L-10 gives the NASA inflation index to be used to calculate real year dollars.

Identify and justify the methodology used to estimate the cost, for example, specific cost model, past performance, cost estimating relationships from analogous missions, and assumptions. Describe the budget reserve strategy, including budget reserve levels as a function of mission phase.

a. Full Cost Accounting

NASA services, facilities, and equipment can be proposed. Where NASA-provided services, facilities and equipment are used, NASA Civil Service labors and supporting NASA Center infrastructure must be costed on a full cost accounting basis. If NASA guidance for full cost accounting has not been fully developed by the closing date for proposal submission, NASA Centers may submit full cost proposals based on the instructions in the NASA Financial Management Manual, Section 9091-5, "Cost Principles for Reimbursable Agreements," or based on their own Center-approved full cost accounting models. Other Federal Government elements of proposals must follow their agency cost accounting standards for full cost. If no standards are in effect, the proposers must then follow the Managerial Cost Accounting Standards for the Federal Government as recommended by the Federal Accounting Standards Advisory Board.

b. NASA ESE Cost

The NASA ESE Cost is the funding that the NASA Earth Science Enterprise would be expected to provide to the mission team over the course of the investigation in real year dollars, beginning with initial selection and ending with the conclusion of data analysis and distribution of data to the scientific community. Examples of costs to be included are any upper stages; flight hardware, including science/applications instrumentation and spacecraft; payload adapter; education and outreach activities; new technology; subcontracting costs (including fees); science/applications teams; all personnel required to conduct the investigation, analyze and publish results, and deliver data in archival format; insurance; ground data system; labor (contractor); NASA Civil Servant costs; reserves; and contract fees. A mission reserve will not be maintained by Office of Earth Science; therefore, each mission must include its own credible mission phased reserve proportional to the development risk. The NASA Earth Science Enterprise costs for the mission is capped at $125 M (real year dollars), excluding launch vehicle and launch services, and proposers are strongly encouraged to propose lower cost missions. The NASA Mission Cost, which is the sum of the ESE Mission Cost and the NASA Launch Services Cost, is a consideration in the selection of investigations and in the continuing assessment of ongoing missions.

c. NASA Launch Services Cost

Launch services are discussed in section 3.1.4 of these instructions. Launch services cost is defined as that portion of the proposed Total Mission Life Cycle Cost to be funded by NASA for the acquisition of a launch vehicle and the services necessary for launch. Elements of this cost include the launch vehicle itself, including any

upper stages, payload fairings, propellants, and labor and materials needed for launching. Elements that are to be included in payload integration costs and that are not part of launch services are elements such as payload adaptors, cabling and connectors to connect the payload to the launch vehicle, and labor, equipment, and materials necessary for health monitoring and maintenance of the payload prior to launch. Launch Services cost is not part of the NASA Earth Science Enterprise Cost ceiling of $125 million discussed elsewhere in these instructions. Proposers must still include the estimated cost of launch services in the cost tables K-10, above, and Figures L-7 and L-8 below for completeness.

d. Goods and/or Services Offered on a No-Exchange-of-NASA-Funds Basis

Contributions of any kind, whether cash or non-cash (cash, property and/or services) to ESSP by organizations other than the Office of Earth Science are encouraged but not required. Values for all contributions of property and services shall be established in accordance with applicable cost principles. Such contributions may be applied to any part or parts of a mission. A letter of endorsement that contains a statement of financial commitment from each responsible organization offering to contribute to the investigation must be submitted with the proposals for all U.S. components. For non-U.S. components of proposals, see Section 3.3.

The cost of contributed hardware or software shall be estimated as either: (1) the cost associated with the development and production of the item if this is the first time the item has been developed and if the mission represents the primary application for which the item was developed; or (2) the cost associated with the reproduction and modification of the item (i.e., any recurring and mission-unique costs) if this is not a first-time development. If an item is being developed primarily for an application other than the one in which it will be used in the proposed investigation, then it may be considered as falling into the second category (with the estimated cost calculated as that associated with the reproduction and modification alone). In this case, document the commitment to complete the development on the part of the organization funding the other application.

The cost of contributed labor and services shall be consistent with rates paid for similar work in the offeror's organization. The cost of contributions shall not include funding spent before the start of the investigation. The value of materials and supplies shall be reasonable and shall not exceed the fair market value of the property at the time of the contribution. NASA will evaluate the realism of all costs regardless of the proposed source.

2. Reserves and Margins

Include a discussion of reserves, margins, and descope options , including the time phasing and critical decision points. Justify the level and allocation of these reserves, margins and descope options based on the level of technical and programmatic risk for your investigation. Discuss the management of the reserves and margins, including

whom in the management organization manages the reserves and when and how the reserves are released.

3. Plans to Resolve Open Cost Issues

   Identify and discuss any unresolved issues. Include your planned approach and schedule for resolving these issues.

Proposals submitted in response to this AO must be of sufficient cost detail to enable NASA to make a fair and reasonable assessment of the NASA Mission Cost (NMC) and the Total Mission Life Cycle Cost (TMLCC) of the proposed Baseline Science Mission. The term "cost" is defined as dollars actually expended for accomplishment of the mission during a given time period. Cost differs from "funding", which is defined in the Funding Profile section below. The NMC represents the NASA-funded portion of the mission. The TMLCC is the total amount of resources used to produce the mission; that is, the NMC plus all non-NASA-funded contributions. This includes direct and indirect costs that contribute to the mission, regardless of funding sources. The NMC for an ESSP mission must include the full cost of all civil service support to the mission, including science co-investigators, technical advisors, facilities, etc., unless contributed by their agency. If contributed, these resources must be included in the TMLCC.

Direct costs that can be specifically identified with an ESSP mission include: (a) salaries and other benefits for employees who work directly on the mission, (b) materials and supplies used directly in support of the mission; (c) various costs associated with office space, equipment, facilities, and utilities that are used exclusively to produce the mission; and (d) costs of goods or services received from other segments or entities that are used to produce the ESSP mission.

Indirect costs include resources that are jointly or commonly used to produce two or more types of products but are not specifically identifiable with any of the products. Typical examples include labor overheads, material handling, cost of money (COM), general administration, general research and technical support, security, rent, employee health and recreation facilities, operating and maintenance costs for buildings, equipment, and utilities.

Cost estimating procedures shall be based upon generally accepted cost accounting principles and practices and must be in accordance with the proposer's approved accounting system. Additional information on cost principles, procedures, and definitions are found in the Federal Acquisition Regulations (FAR) in parts 30 and 31.

The methods by which the cost estimates are derived shall be described. If an estimate is based on heritage, the performance and cost parameters that the proposed system has in common with the previous or existing system shall be provided. An analysis of the impact of the referenced heritage on the risk of the proposed mission and on the proposed mission cost estimate shall also be provided. If cost models are used, a description of the model and the assumptions used to derive the cost estimates shall be documented. Identify any "discounts"

assumed in the cost estimates for business practice initiatives or streamlined technical approaches. Describe how these have been incorporated in the cost estimate.

Copies of applicable forward pricing rate agreements shall be provided. Costing of Federal Government elements of proposals must follow the agency cost accounting standards for full cost (see paragraph M.1.a, above).

All costs, including non-U.S. contributions, must be in U.S. Government real year dollars. Real year dollars are current fiscal year (FY) dollars adjusted to account for inflation in future years; in other words: real year dollars are what you will have to actually spend in each future year. The inflation rate index provided in Appendix L, Figure L-10 shall be used to calculate all real year dollar amounts unless an industry forward pricing rate is used and documented. Where cost phasing is requested, the cost plan shall provide data by U.S. Government fiscal year (October 1 - September 30) for phases Mission Detailed Design through Mission Operations and Data Analysis, Archival, and Dissemination and by Government fiscal quarter for phase Mission Definition and Preliminary Design. Requests for cost by "Phase" refer to Phases Mission Definition and Preliminary Design through Mission Operations and Data Analysis, Archival, and Dissemination as defined in Section 3.2 of this AO. Costs shall be broken down to the system or subsystem level, as requested, in accordance with the proposed Work Breakdown Structure (WBS), which shall be included for reference.

Separate Phase Cost Breakdown by WBS and Major Cost Category and Government fiscal year (fiscal quarter for phase Mission Definition and Preliminary Design) shall be provided at the appropriate WBS level for each major mission organization (i.e., the PI, each NASA-funded team member, each contributor, and each subcontract exceeding $1,000,000) as defined below. In addition, a roll-up Summary of Elements of Cost shall be provided for each organization. Appendix L, Figure L-8 is provided as a template for these costs. This format can be expanded to show additional phases and fiscal years. Major categories of cost shall be provided at the subsystem level for the flight system, including the science instruments, and at least the system level for all other items. The value of reserves shall be included and separately identified by WBS at the system level. A mission level Summary of Elements of Cost for the total ESE Cost, NASA Launch Services Cost, and the TMLCC, which represents the total of all separate Summaries, shall also be provided, but need not be broken down by skill categories, overhead centers, etc.

The Summaries of Elements of Cost shall contain the following direct and indirect elements:

- DIRECT LABOR HOURS - Show productive hours by individual skill categories for phases Mission Definition and Preliminary Design through Mission Operations and Data Analysis, Archival, and Dissemination.

- DIRECT LABOR COSTS – The labor costs shall be itemized by skill categories for phases Mission Definition and Preliminary Design through Mission Operations and Data Analysis, Archival, and Dissemination.

- LABOR OVERHEAD - Overhead shall be itemized by cost centers (engineering, manufacturing, etc.) for phase Mission Definition and Preliminary Design and as totals by fiscal year for phases Mission Detailed Design through Mission Operations and Data Analysis, Archival, and Dissemination . Rates shall be documented for phases Mission Definition and Preliminary Design through Mission Operations and Data Analysis, Archival, and Dissemination.

- SUBCONTRACTS - Supporting information shall be provided for all subcontracts exceeding $500,000 for phases Mission Definition and Preliminary Design through Mission Operations and Data Analysis, Archival, and Dissemination. This detail shall include name/address, cost, fee/profit, type of contract, number of quotes solicited/received, basis of selection, affiliation with the Prime, type of business, type of cost and price analysis accomplished, concise basis of estimate, and basis of selection.

- MATERIALS - Supporting detail for major vendors (exceeding $500,000) in phases Mission Definition and Preliminary Design through Mission Operations and Data Analysis, Archival, and Dissemination shall include WBS element, fiscal year or quarter, description, vendor name/address, quantity, and current/proposed unit prices. Material burden rates shall be documented for phases Mission Definition and Preliminary Design through Mission Operations and Data Analysis, Archival, and Dissemination.

- TRAVEL - Travel shall be summarized as totals for phases Mission Definition and Preliminary Design through Mission Operations and Data Analysis, Archival, and Dissemination. A table shall be included that provides the basis of estimate for travel costs. This shall include, but is not limited to, number of travelers, destinations, number of days, airfare cost, rental car cost, per diem costs (hotel, meals, etc.), etc.

- OTHER DIRECT COSTS - Other direct costs shall be summarized as totals for phases Mission Definition and Preliminary Design through Mission Operations and Data Analysis, Archival, and Dissemination.

- GENERAL AND ADMINISTRATIVE (G&A) EXPENSE - G&A expense represents the institution's general and executive offices and other miscellaneous expenses related to business. G&A expense shall be itemized by cost pool for the Mission Definition and Preliminary Design phase and summarized as totals for phases Mission Detailed Design through Mission Operations and Data Analysis, Archival and Dissemination . Rates shall be documented for phases Mission Definition and Preliminary Design through Mission Operations and Data Analysis, Archival, and Dissemination.

- COST OF MONEY (COM) - COM represents interest on borrowed funds invested in facilities. COM shall be itemized by indirect pools and overhead centers for the Mission Definition and Preliminary Design phase and summarized as totals by fiscal year for phases Mission Definition and Preliminary Design through Mission Operations and Data Analysis, Archival, and Dissemination. Rates shall be documented for phases Mission Definition and Preliminary Design through Mission Operations and Data Analysis, Archival, and Dissemination.

- PROFIT/FEE - Document the basis, rate, and amount of fee for phases Mission Definition and Preliminary Design through Mission Operations and Data Analysis, Archival, and Dissemination.

- ESCALATION FACTORS - Document the escalation factors used to determine real year dollars for phases Mission Definition and Preliminary Design through Mission Operations and Data Analysis, Archival, and Dissemination.

In addition to the Summaries of Elements of Cost, the proposer shall provide the following mission level information:

- Total costs will always equal total funding at program completion.

- SUMMARY OF COST RESERVES - A time phased summary of cost reserves shall be presented by Phase for all WBS elements that contain reserve. The proposed cost by element, the amount of reserve for each element, and the reserve as a percentage of the TMLCC for each element shall be provided. A rolled up summary of cost reserves, which represents a total of reserves for all WBS elements shall also be provided.

- DESCOPE OPTIONS - The cost savings associated with all descope options presented in the Management section shall be time-phased and provided for all mission phases.

- FUNDING PROFILE - Provide a profile of required NASA-funding by fiscal year. The funding profile is derived from the cost profile that is the basis of the proposal. The funding for a given fiscal year is determined from the estimated costs in that year, less the funding carried over from the previous fiscal year, plus the forward funding needed to cover the costs of the first month in the following fiscal year, plus the forward funding required for "unfilled orders". Unfilled orders refer to long lead items for which funding and costing takes place in different Government fiscal years. Because of forward funding, costs will not equal funding in any given fiscal year. Total costs shall equal total funding at program completion.

  Appendix L, Figure L-7 is provided as a template for the TMLCC phasing by fiscal year. Resources provided as contributions by international or other partners shall be included and clearly identified as separate line items. This is the only chart where NASA-funded costs and contributions by other partners are presented together.

Note:

Step-Two proposals at minimum must cover the following items

1. **Complete Volume II required**

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Earth System Science Pathfinder (ESSP) AO
Section B - Investigation Summary Form I

AO XX-OES-XX ESSP Announcement of Opportunity	Proposal No. _____ *NASA Use Only*
Principal Investigator *Title* *First Name* *Middle Name* *Last Name*	
Department	
Company/Institution	
Street Address	City/Town
State	Zip/Postal Country
Telephone	Fax E-Mail Address
Proposal Title	

Science/Application Research Supported

[ ] Earth System Variability and Trends
[ ] Primary Forcings of the Earth System
[ ] Earth System Responses and Feedback Processes
[ ] Other (Specify) _____

(As listed in NASA's Earth Science Research Strategy for 2000-2010 (Appendix A))

Scientific Theme, Application Research or Commercial Development topic: _____

Abstract (Limit 150 words)

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Earth System Science Pathfinder (ESSP) AO Form
Section B - Investigation Summary Form II

AO XX-OES-XX ESSP Announcement of Opportunity	Proposal No. _____ *NASA Use Only*
Principal Investigator *Title* *First Name* *Middle Name* *Last Name*	
Proposal Title	

Mission Mode [ ] Complete Mission [ ] Partial Mission	Cost (real year dollars) NASA ESE Cost $_____ NASA Mission Cost $ _____ Total Mission Life Cycle Cost $_____
Anticipated Launch Vehicle:	Anticipated Launch Date:
Anticipated Instrument Carrier (if applicable):	

Press Release Abstract (50 words)

Co-Investigator(s)

Name	Institution	Responsibility	Funded	E-Mail

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Example Letter of Endorsement for Co-I's and Subcontracts valued at $500K or less

[Letterhead]

[Date]

[To Address]

Dear XXXXX,

If the proposal XXXXXXXX by PI Dr. XXXXXXXX is selected, we will provide the following goods and/or services:

- XXXXXXXXX $XX
- XXXXXXXXXXX XXXXX Hours $XX
- XXXXXXXXXXXXXXXXXX $XX
- XXXXXX $XX

Our estimated total cost for this task is $XXXX, subject to final negotiations.
Attached is a detailed description of how our costs were estimated.

Sincerely,

[Signature, name, and title of official
authorized to commit this organization
to participate in the proposed investigation.]

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APPENDIX L

CHARTS AND TEMPLATES

Technology Definitions

Technology Readiness Levels (TRL), Research vs. Development, Relevant Cross-cutting Processes

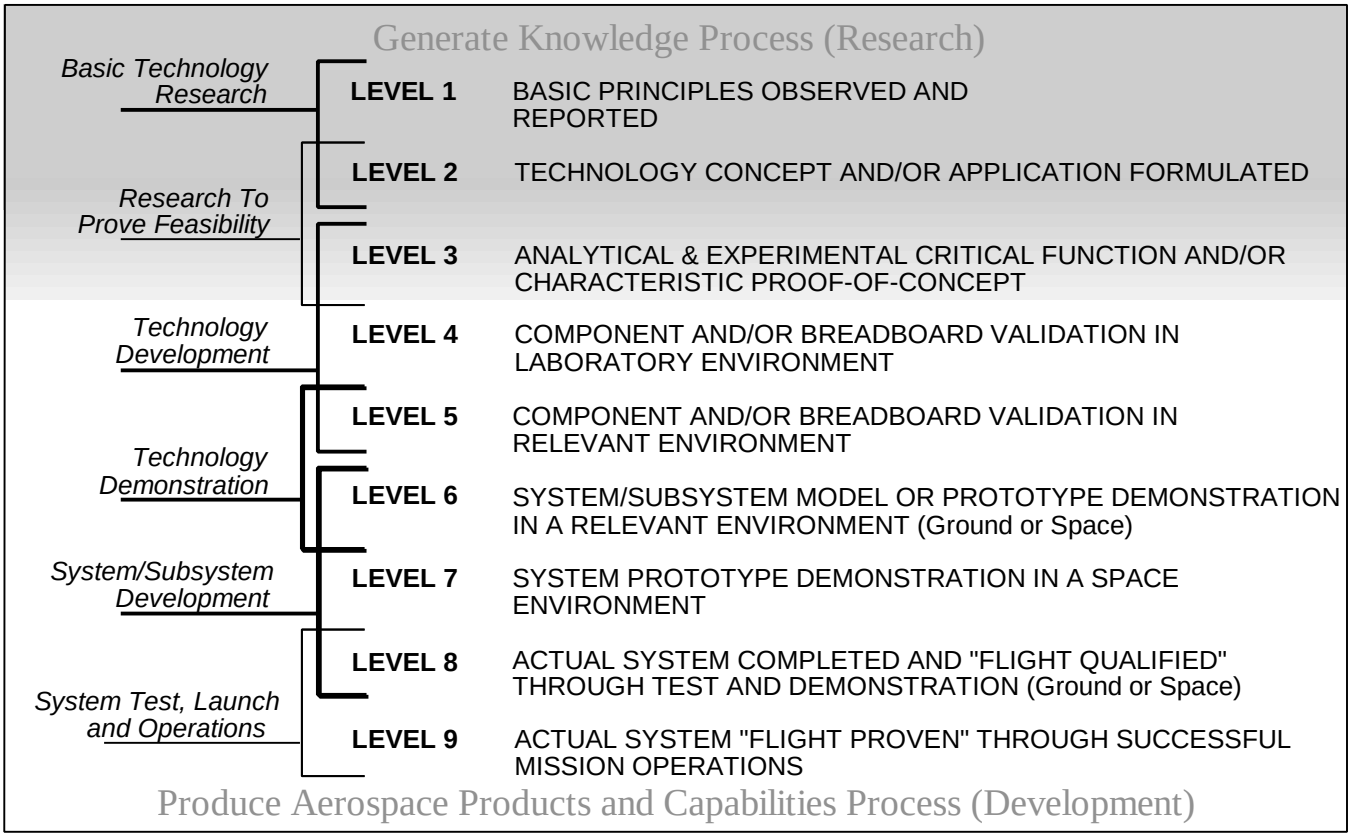

Figure L-1. Technology Readiness Level Definitions

Name of Hardware Item	Item Description	Maturity Level	Rationale for Maturity Assessment

Figure L-2. Technical Maturity Matrix

Science Objectives	Scientific Measurement Requirements	Instrument Functional Requirements	Mission Functional Requirements (Top-Level)

Figure L-3. Science Traceability Matrix

Science Measurement Requirement	Mission Requirement	Instrument Requirement	Spacecraft Requirement	Ground System Requirement	Operations Requirement

Figure L-4. Mission Traceability Matrix

Mission Assurance Element	Check all that apply	Applicable Plan, Document, Review or Program
1. Mission Assurance Program 2.1 Quality System 2.2 Standards 2.3 Non-Conformance Reporting 2.4 Operating Time 3. Reviews System Requirements Review Preliminary Design Review Critical Design Review Pre-Environmental Test Review Mission Readiness Review Launch Readiness Review Operational Acceptance Review Annual Operation Reviews 4.1 Parts Program 4.2 Materials and Processes Program 4.3 Reliability Program 4.4 Software Development Program 5. Verification Program 6. Contamination Control Program		

Figure L-5. Mission Assurance Compatibility Table

						TOTALS
Cost Element **	FY2001	FY2002	FY2003	...	FYn	RY $K
Phase Mission Definition (if required)						
Reserves						
Total Phase Mission Definition						
Phase Preliminary Design						
Reserves						
Total Phase Preliminary Design						
Phase Mission Detailed Design, & Mission Development and Launch	Enter each cost element					
Proj. Mgmt/Misn. Analysis/Sys. Eng.						
Instrument A						
Instrument B						
Instrument ...						
Instr. Integr., Assy. & Test						
Subtotal - Instruments						
Spacecraft bus						
Spacecraft Integr., Assy. & Test						
Other Hardware Elements (1)						
Subtotal - Spacecraft						
Pre-Launch GDS/MOS Development						
Science Team Support						
Launch Ops (Launch + 30 Days)						
Other (2)						
Subtotal Phase before Reserves						
Instrument Reserves						
Spacecraft Reserves						
Other Reserves						
Total Phase Mission Detailed Design, & Mission Development and Launch						
Phase Mission Operations and Data Analysis, Archival, and Dissemination	Enter each cost element					
MO & DA						
DSN/Tracking						
Other (2)						
Subtotal Phase before Reserves						
Reserves						
Total Phase Mission Operations and Data Analysis, Archival, and Dissemination						
Education						
Total NASA ESE Cost						
Launch Services						
Total NASA Cost						
Contributions (2)						
Total Contributions						
Total Mission Cost =					→	

** Refer to definition of Program Cost Elements

(1) Other Hardware Elements: Probes, Sample Return Canister, Etc.

(2) Specify each item on a separate line; include Education & Public Outreach, facilities, etc.

Figure L-6. Summary of Elements Of Cost for the Entire Project in Real Year $K

Cost Element**	FY2001	FY2002	FY2003	FY2004	FY2005	FY2006	...	FYn	Total (Real Yr. $K)
Phase Mission Definition and Preliminary Design	$	$	$	$	$	$	$	$	$
- Organization A									
- Organization B									
- etc.									
Phase Mission Detailed Design, & Mission Development and Launch	$	$	$	$	$	$	$	$	$
- Organization A									
Phase Mission Operations and Data Analysis, Archival, and Dissemination	$	$	$	$	$	$	$	$	$
- Organization A									
Shuttle/ELV and services	$	$	$	$	$	$	$	$	$
- Organization A									
Other Tracking Support	$	$	$	$	$	$	$	$	$
- Organization A									
Other (specify)	$	$	$	$	$	$	$	$	$
Total Cost to NASA	$	$	$	$	$	$	$	$	$
Additional Contributions by Organization (Foreign or Domestic) to:									
Total Phase Mission Definition and Preliminary Design	$	$	$	$	$	$	$	$	$
- Organization A									
Total Phase Mission Detailed Design, & Mission Development and Launch	$	$	$	$	$	$	$	$	$
- Organization A									
Total Phase Mission Operations and Data Analysis, Archival, and Dissemination	$	$	$	$	$	$	$	$	$
- Organization A									
Shuttle/ELV Costs	$	$	$	$	$	$	$	$	$
- Organization A									
Tracking Support	$	$	$	$	$	$	$	$	$
- Organization A									
Other	$	$	$	$	$	$	$	$	$
Contributed Costs (Total)	$	$	$	$	$	$	$	$	$
						Mission Totals			$

* Costs shall include all costs including fee

** See Program Cost Element definitions

Figure L-7. Total Mission Life Cycle Cost Phasing (FY Costs* in Real Year $K, Totals in Real Year $K)

PHASE _____ COST BREAKDOWN BY WBS AND MAJOR COST CATEGORY (Phased costs in Real Year Dollars, Totals in Real Year Dollars)					
WBS/Cost Category Description*	FY2001	FY2002	• • •	Total (RY$)	Leave this column blank
Total Direct Labor Cost	$	$	$	$	
WBS 1.0 Management					
WBS 2.0 Spacecraft					
WBS 2.1 Structures & Mechanisms					
WBS 2.2 Propulsion					
Etc.					
Total Direct Material and Equipment Costs	$	$	$	$	
WBS # and Description					
:					
Total Other Direct Costs	$	$	$	$	
WBS # and Description					
:					
Total Subcontracts	$	$	$	$	
WBS # and Description					
:					
Total Indirect Costs	$	$	$	$	
WBS # and Description					
:					
Total Reserves	$	$	$	$	
WBS # and Description					
:					
Fee					
Other (Specify)					
Total Contract Cost	$	$	$	$	
Total Other Costs to NASA	$	$	$	$	
Shuttle/ELV and Launch Services					
Other (Specify)					
Total Contributions (Foreign or Domestic)	$	$	$	$	
Organization A:					
WBS # and Description					
etc.					
Organization B:					
WBS # and Description					
etc.					
TOTAL COST FOR PHASE	$	$	$	$	

Figure L-8 Phase Cost Breakdown by WBS and Major Cost Category Template

Development Costs in Real Year Dollars (to nearest thousand)

			TOTALS
Cost Element **	Non-Recurring (RY$)	Recurring (RY$)	RY $
Instrument A (1)			
Instrument B (1)			
:			
Instrument n (1)			
Subtotal - Instruments			
Structure & Mechanisms			
Propulsion			
Power			
:			
Each Subsystem			
Subtotal - Spacecraft Bus			
Instrument Software			
Spacecraft Bus Software			
Ground Systems Software			
Subtotal - Software			
Other Elements (2)			
Subtotal - Element			
:			
:			
Total Development			

** Refer to definition of Program Cost Elements

(1) Specify each instrument by subsystems/components where possible

(2) Other Elements: Probes, Sample Return Canister, etc. Specify each separately, by subsystem wherever possible

Figure L-9 Costs for all Development Elements by Recurring and non-recurring Components Template

Fiscal Year	Inflation Rate
FY 2002	2.8%
FY 2003	2.8%
FY 2004	2.8%
FY 2005	2.8%
FY 2006 and Outyears	2.8%

Figure L-10. NASA Inflation Index

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APPENDIX M

AO ACRONYMS

AA	Associate Administrator (Office of Earth Science)
ADEOS	Advanced Earth Observation Satellite
AO	Announcement of Opportunity
AMM	Antarctic Mapping Mission
ASCII	American Standard Code for Information Interchange
CCSDS	Consultative Committee for Space Data Systems
CDR	Critical Design Review
CRR	Critical Readiness Review
COM	Cost of Money
COTS	Commercial Off-The-Shelf
CRSP	Commercial Remote Sensing Program
CVCM	Collected Volatile Condensable Mass
DAAC	Distributed Active Archival Centers
DIF	Directory Interchange Format
DOS	Disk Operating System
DPA	Destructive Physical Analysis
EEE	Electrical, Electronic, and Electro-Mechanical
EEO	Equal Employment Opportunity
ELV	Expendable Launch Vehicle
EOCAP	Earth Observations Commercial Applications Program
EOS	Earth Observing System
EOSDIS	Earth Observing System Data and Information System
ERS	European Remote-sensing Satellite
ESE	Earth Science Enterprise
ESIP	Earth Science Information Partners
ESSP	Earth System Science Pathfinder
ETR	Eastern Test Range
EWR	Eastern and Western Range
EXPRESS	EXpedite the PRocessing of Experiments for the Space Station
FAR	Federal Acquisition Regulation
Fax	Facsimile
FFRDC	Federally Funded Research and Development Center
FGDC	Federal Geographic Data Committee
FMEA	Failure Modes and Effects Analysis
FY	Fiscal Year
G&A	General and Administrative
GCMD	Global Change Master Directory
GDS	Ground Data System
GIDEP	Government Industry Data Exchange Program
GLAS	Geoscience Laser Altimeter System
GPS	Global Positioning System

GRACE	Gravity Recovery and Climate Experiment mission
GSE	Ground Support Equipment
GSFC	Goddard Space Flight Center
HBCUs	Historically Black Colleges and Universities
HDF	Hierarchical Data Format
HH	Horizontal linear polarized beam transmitted and received
IIP	Instrument Incubator Program
IPCC	Intergovernmental Panel on Climate Change
ISO	International Organization for Standardization
ISS	International Space Station
JERS	Japanese Earth Resources Satellite
JPL	Jet Propulsion Laboratory
KSC	Kennedy Space Center
Landsat	Visible/near visible band Earth-imaging series of satellites
LightSAR	Lightweight Synthetic Aperture Radar
LSWG	LightSAR Science Working Group
LRR	Launch Readiness Review
LTA	Long Term Archive
METOP	METeorological OPerational
MCR	Mission Confirmation Review
MDR	Mission Design Review
MLELV	Medium-Light Expendable Launch V ehicle
MODIS	Moderate Resolution Imaging Spectrometer
MRR	Mission Readiness Review
MTPE	Mission To Planet Earth (now known as Earth Science Enterprise)
NAS	National Academy of Sciences
NASA	National Aeronautics and Space Administration
NFS	NASA FAR Supplement
NHB	NASA Handbook
NMC	NASA Mission Cost
NMP	New Millennium Program
NOI	Notice of Intent
NPD	NASA Policy Directive
NPG	NASA Procedures and Guidelines
NRA	NASA Research Announcement
NRC	National Research Council
NSS	NASA Safety Standard
OAR	Operational Acceptance Review
OES	Office of Earth Science
OFCCP	Office of Federal Contract Compliance Programs
OMUs	Other Minority Universities
PAF	Payload Attach Fitting
PDR	Preliminary Design Review
PER	Pre-Environmental Review
PI	Principal In vestigator
PM	Project Manager

Radarsat	C-band imaging radar satellite of the Canadian Space Agency
SAR	Synthetic Aperture Radar
SDAP	Science Data Analysis Program
SE	Support Equipment
SELV	Small Expendable Launch Vehicle
SELVS	Small Expendable Launc h Vehicle Services
SERF	Services Entry Record File
SF	Standard Form
SI	International System of Units
SIR-C	Shuttle Imaging Radar - C
SOMO	Space Operations Management Office
SOW	Statement of Work
SRR	System Requirements Review
SRM	Solid Rocket Motor
SSC	John C. Stennis Space Center
TML	Total Mass Loss
TMLCC	Total Mission Life Cycle Cost
TRL	Technology Readiness Level
URL	Universal Resource Locator
USGCRP	U.S. Global Change Research Program
VCL	Vegetation Canopy Lidar Mission
VV	Vertical linea r polarized beam transmitted and received
WBS	Work Breakdown Structure
WFF	Wallops Flight Facility
WORF	Window Observational Research Facility
WTR	Western Test Range
WWW	World Wide Web
X-SAR	X-band Synthetic Aperture Radar

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APPENDIX N

GLOSSARY OF TERMS

NASA EARTH SCIENCE ENTERPRISE COST

That portion of the proposed Total Mission Life Cycle Cost to be funded by NASA for the development, integration, and operation of all hardware and software, including full costing of non-contributed Civil Service resources. This cost excludes the cost of the launch vehicle and launch services.

NASA LAUNCH SERVICES COST

That portion of the proposed Total Mission Life Cycle Cost to be funded by NASA for the acquisition of a launch vehicle and the services necessary for launch.

NASA MISSION COST

That portion of the proposed Total Mission Life Cycle Cost to be funded by NASA, including full costing of non-contributed civil service resources. This includes both the NASA Earth Science Enterprise Cost and the NASA Launch Services Cost.

CONTRIBUTIONS

That portion of the proposed Total Mission Life Cycle Cost that is provided on a no-exchange-of-NASA-funds basis.

TOTAL MISSION LIFE CYCLE COST

The total proposed mission cost, which is the sum of the NASA Mission Cost and all Contributions from the selected proposal Team partners.

COST CEILING

The maximum cost allowed under this AO. The NASA ESE Cost Ceiling for this AO is $125M.

COST CAP

The cost limit, less than or equal to the cost ceiling, that the proposer commits to upon submission of the Step-Two proposal.

MISSION DEFINITION AND PRELIMINARY DESIGN PHASE

Project Formulation period that includes definition and preliminary design.*

MISSION DETAILED DESIGN AND MISSION DEVELOPMENT AND LAUNCH PHASES

Project Implementation period that includes detail design and development, mission launch, and operational validation.*

MISSION OPERATIONS AND DATA ANALYSIS, ARCHIVAL, AND DISSEMINATION Phase

Project Implementation period that includes mission operations, data collection, processing, distribution, and archiving.*

SCIENCE RETURN

The combination of the proposed mission's relevance to the science priorities, goals and objectives of the Earth Science Enterprise and Earth Exploratory Mission Program; overall scientific merit; and quality, quantity, relevance and timeliness of deliverable science data products.

SCIENCE VALUE

An assessment of the relationship between science return and the proposed NASA Mission Cost.

*Note: phases Mission Definition and Preliminary Design through Mission Operations and Data Analysis, Archival, and Dissemination, as defined in section 3.2, correspond to a calendar sequence of project milestones (phase A through phase E) defined in the now-superceded NHB7120.5. This terminology is used for consistency in this AO, such as cost estimation consistency in AO proposals.

APPENDIX O

CERTIFICATION REGARDING DEBARMENT, SUSPENSION, AND OTHER RESPONSIBILITY MATTERS PRIMARY COVERED TRANSACTIONS

This certification is required by the regulations implementing Executive Order 12549, Debarment and Suspension, 14 CFR Part 1265.

A. The applicant certifies that it and its principals:

(a) Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency;
(b) Have not within a three-year period preceding this application been convicted or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State, or Local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;
(c) Are not presently indicted for or otherwise criminally or civilly charged by a government entity (Federal, State, or Local) with commission of any of the offenses enumerated in paragraph A.(b) of this certification;
(d) Have not within a three-year period preceding this application/proposal had one or more public transactions (Federal, State, or Local) terminated for cause or default; and

B. Where the applicant is unable to certify to any of the statements in this certification, he or she shall attach an explanation to this application.

C. Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion - L owered Tier Covered Transactions (Subgrants or Subcontracts)

(a) The prospective lower tier participant certifies, by submission of this proposal, that neither it nor its principles is presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participation in this transaction by any federal department of agency.
(b) Where the prospective lower tier participant is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this proposal.

Organization Name AO Number and Title

Printed Name and Title of Authorized Representative

Signature Date

Printed Proposal Team Leader Name Proposal Title

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APPENDIX P

CERTIFICATION REGARDING LOBBYING

As required by S1352 Title 31 of the U.S. Code for persons entering into a grant or cooperative agreement over $100,000, the applicant certifies that:

(a) No Federal appropriated funds have been paid or will be paid by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, in connection with making of any Federal grant, the entering into of any cooperative, and the extension, continuation, renewal, amendment, or modification of any Federal grant or cooperative agreement;

(b) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting an officer or employee of any agency, Member of Congress, or an employee of a Member of Congress in connection with this Federal grant or cooperative agreement, the undersigned shall complete Standard Form - LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

(c) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subgrants, contracts under grants and cooperative agreements, and subcontracts), and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by S1352, Title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

Organization Name	AO Number and Title
Printed Name and Title of Authorized Representative	
Signature	Date
Printed Proposal Team Leader Name	Proposal Title

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APPENDIX Q

CIVIL RIGHTS CERTIFICATION

Assurance of Compliance with the National Aeronautics and Space Administration Regulations Pursuant to Nondiscrimination in Federally Assisted Programs

The _____,
(*Institution, corporation, firm, or other organization on whose behalf this assurance is signed, hereinafter called "Applicant")*

HEREBY AGREES THAT it will comply with Title VI of the Civil Rights Act of 1964 (P.L. 88-352), Title IX of the Education Amendments of 1962 (20 U.S.C. 1680 et seq.), Section 504 of the Rehabilitation Act of 1973, as amended (29 U.S.C. 794), and the Age Discrimination Act of 1975 (42 U.S.C. 16101 et seq), and all requirements imposed by or pursuant to the Regulation of the National Aeronautics and Space Administration (14 CFR Part 1250) (hereinafter call "NASA") issued pursuant to these laws, to the end that in accordance with these laws and regulations, no person in the United States shall, on the basis of race, color, national origin, sex, handicapped condition, or age be excluded from participation in, be denied the benefits of, or be otherwise subjected to discrimination under any program or activity for which the Applicant receives federal financial assistance from NASA; and HEREBY GIVE ASSURANCE THAT it will immediately take any measure necessary to effectuate this agreement.

If any real property or structure thereon is provided or improved with the aid of federal financial assistance extended to the Applicant by NASA, this assurance shall obligate the Applicant, or in the case of any transfer of such property, any transferee, for the period during which the real property or structure is used for a purpose for which the federal financial assistance is extended or for another purpose involving the provision of similar services or benefits. If any personal property is so provided, this assurance shall obligate the Applicant for the period during which it retains ownership or possession of the property. In all other cases, this assurance shall obligate the Applicant for the period during which the federal financial assistance is extended to it by NASA.

THIS ASSURANCE is given in consideration of and for the purpose of obtaining any and all federal grants, loans, contracts, property, discounts, or other federal financial assistance extended after the date hereof to the Applicant by NASA, including installment payments after such date on account of applications for federal financial assistance which were approved before such date. The Applicant recognized and agrees that such federal financial assistance will be extended in reliance on the representations and agreements made in this assurance, and that the United States shall have the right to seek judicial enforcement of this assurance. This assurance is binding on the Applicant, its successors, transferees, and assignees, and the person or persons whose signatures appear below are authorized to sign on behalf of the Applicant.

Dated: _____ Applicant: _____

By:_____
(*President, Chairman of Board, or Comparable Authorized Person)*

_____

_____
(Applicant's mailing address)

OR USE NASA FORM 1206 AUG 97 PREVIOUS EDITIONS ARE OBSOLETE

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APPENDIX R

SAMPLE MISSION DEFINITION AND REQUIREMENTS AGREEMENT

MISSION DEFINITION AND REQUIREMENTS AGREEMENT

for the

GRAVITY RECOVERY AND CLIMATE EXPERIMENT (GRACE) MISSION

UNIVERSITY OF TEXAS
CENTER FOR SPACE RESEARCH

July 31,1997

1.0 MISSION OVERVIEW

The primary goal of the GRACE mission is to obtain accurate global and high-resolution models for both the static and the time variable components of the Earth's gravity field. This goal will be achieved by making accurate measurements of the inter-satellite range and range rate between two co-planar, low altitude polar orbiting satellites, using a micro-wave tracking system. In addition, each satellite will carry geodetic quality Global Positioning System (GPS) receivers and high accuracy accelerometers to enable accurate orbit determination, spatial registration of gravity data and the estimation of gravity field models.

The gravity field estimates obtained from data gathered by the GRACE mission will provide, with unprecedented accuracy, integral constraints on the global mass distribution and its temporal variations. In the oceanographic community, the knowledge of the static geoid, in conjunction with satellite altimeter data, will allow significant advances in the studies of oceanic heat flux, long term sea level change, upper oceanic heat content, and the absolute surface geostrophic ocean currents. Further, the estimates of time variations in the geoid obtained from GRACE, in conjunction with other in-situ data and geophysical models, will help the science community unravel complex processes in oceanography (e.g. deep ocean current changes and sea level rise), hydrology (e.g. large scale evapo-transpiration and soil moisture changes), glaciology (e.g. polar and Greenland ice sheet changes), and the solid Earth Sciences.

This mission will be relevant to the goals of both MTPE EOS and the USGCRP. Implementation of the mission will be efficient and cost effective due to international collaboration. The GRACE Principal Investigator (PI), Dr. Byron Tapley of the University of Texas, Austin Center for Space Research (UTCSR), has established teaming arrangements with a Co-Principal Investigator, Prof. Dr. Christoph Reigber of the GeoForschungZentrum (GFZ), Germany; the Jet Propulsion Laboratory (JPL), Space Systems Loral (SS/L), the Dornier Satelliten Systeme, GmbH, the Applied Physics Laboratory (APL) at Johns Hopkins University, ONERA and the Langley Research Center (LaRC) to implement the GRACE mission. The PI will have overall responsibility for the total mission, including the instrument, spacecraft, ground system, mission planning and operations, data processing and analysis, and data distribution. Dr. Tapley will be supported by experienced management and engineering teams, which have established close and efficient working relationships. The Deutsche Forschungsanstalt fur Luft and Raumfahrt (DLR) and GFZ will work under an International Memorandum of Understanding (IMOU) between NASA and DARA (Germany). JPL and LaRC will perform under task orders from the Goddard Space Flight Center (GSFC) ESSP Project Office. SS/L, Dornier, APL and ONERA will perform under contract with JPL.

2.0 SCIENCE OBJECTIVES

2.1 Baseline Science Mission

Primary Objective:

The primary objective of the GRACE mission is to provide gravity models with accuracies that better existing global and high spatial resolution models of the Earth's gravity field by at least an order of magnitude, on a monthly basis, for a period of up to 5 years. The temporal sequence of gravity field estimates provides the mean (or static) gravity field, as well as a time history of its temporal variability. The scientific data products to be generated by GRACE including the line of sight inter-satellite tracking, GPS and accelerometer measurements, along with the ancillary data will be made available to the science community via the PODAAC at JPL in an EOS compatible format, shortly after validation for the entire life of the mission.

Secondary Objectives:

The secondary objectives are related to demonstrating the ability of the gravity measurements to discriminate time varying changes in the mass of the Earth's dynamic system, and to provide additional data to support investigation of the Earth's atmosphere. Specifically, these secondary objectives are:

- To demonstrate the ability to monitor the time varying effects due to sea level rise, water storage, ice change, and other geophysical phenomena, from a temporal sequence of gravity measurements.

- To advance atmospheric model studies by collecting several hundred globally distributed profiles of the ionosphere and the atmosphere every 24 hours, using GPS limb-sounding.

Baseline Science Objectives Summary

Accurate and high resolution estimates of the mean and time variable parts of the Earth gravity field will be obtained from satellite-to-satellite tracking data gathered from the GRACE mission. The mean value and time variations of the spherical harmonic coefficients of the Earth gravity field will be estimated using 12 to 24 day batches or cycles of these data. The accuracy of the estimated spherical harmonic coefficients can be expressed as the global root mean square (rms) error in the resulting area mean geoid height over a disk of a specified radius (or spatial resolution). Using 90 days of data, the nominal GRACE mission scenario will yield geoid height accuracies of better than 0.01 mm for spatial resolutions larger than 3000 km, increasing to 0.02 mm at 1000 km, 0.05 mm at 500 km and 5 mm at 100 km spatial resolutions.

These nominal GRACE gravity field estimation errors can be further specified in terms of the primary science applications, as detailed in the original proposal. Table 1 presents the spatial and, where appropriate, temporal scales for the associated geoid accuracy requirements to support each scientific applications

Table 1 Baseline science objectives summary

APPLICATION	SPATIAL RESOLUTION	TIME SCALE	ACCURACY	COMMENTS
STATIC GRAVITY FIELD				
Oceanic Heat Flux	> 1000 km		> 40 percent improvements	
Ocean Currents	> 1000 km		< 1 mm geoid error	Improves to <0.1 mm for longest scales
Solid Earth Sciences	200 km		approx. 1 cm geoid error	
TIME VARIABLE GRAVITY FIELD				
Ocean Bottom Pressure	> 500 km	Seasonal	0.05 mBar pressure	90 day estimate
Deep Ocean Currents	> 500 km	Seasonal	1 cm/sec current velocity	90 day estimate
Sea Level Rise	> 700 km	Secular	0.1 mm/yr. water level	5 year estimate
Evapo - Transpiration	> 300 km	Seasonal	< 1 cm water equivalent	30 day estimate
Aquifer Depletion	> 300 km	Secular	1 - 2 mm/year water equivalent	5 year estimate
Greenland / Antarctic Ice		Secular	0.4 - 0.8 mm/yr. ice thickness	5 year estimate
- do -		Seasonal	3 - 10 mm ice thickness	1 year estimate

2.2 Minimum Science Mission

As a minimum goal for a successful mission, the GRACE measurements shall support the requirement for at least an order of magnitude improvement in the marine geoid. This improvement will enhance dramatically the recovery of the general ocean circulation and ocean heat flux from satellite altimetry. This improvement is a current requirement of both the MTPE EOS and the World Ocean Circulation Experiment. To achieve minimum objectives of the GRACE mission, a static gravity field with a cumulative error of 5 mm root mean square over wavelengths 800 km and longer shall be obtained. This will require separating the static and time varying signals during the observation interval. This goal shall be readily attainable on the basis of one year of calibrated and validated data from GRACE's dual satellite microwave tracking system.

2.3 Science Data Products

2.3.1 Science Data Rights

There will be no proprietary science data rights for the mission. Science data will be made available to the public and the science community in an EOS compatible format after the appropriate science calibration and validation. The data and the associated higher level products will be made available in batches or cycles of 14 to 30 days each.

The Level-1 data products include the calibrated and verified satellite-to-satellite line of sight biased range and range rate, along with the GPS tracking data and precise ephemeredes for the GRACE satellites. These data will be made available to the scientific community within 30 days of the last observation in each cycle.

The Level-2 data products include validated solutions for cycle averages of the Earth gravity field, in the form of coefficients of a spherical harmonic expansion and their time variations. These data products will be provided along with the equivalent 1x1 degree area mean geoid height and gravity anomalies on a global and regional basis. In addition, the one year average Earth gravity field model in the form of spherical harmonic coefficients as well as geoid height and gravity anomaly maps will be provided. The Level-2 products will be made available within 90 days of the last observation in each cycle.

The Level-3 data products contain higher level solutions targeted for geophysical quantities of interest. These include apparent changes in the 500 km disk averaged ocean bottom pressure as well as continental water storage over each cycle or averaging interval, as well as their longer term (annual and secular) variations. The Level-3 data products will be funded through a separate GRACE Mission Science Data Analysis Program and will be available on a schedule that is consistent with the selected investigation objectives.

2.3.2 Measurement Requirements

The Level 1 science measurement requirements are contained in Table 2. These requirements are consistent with successful accomplishment of the science objectives listed in paragraph 2.1 above.

Table 2 Level 1 Science Requirements

Science Investigation	Instrumentation	S/C	Ground Ops	Mission Design	Mission Ops.	Comments
Earth Gravity Field	m-wave SST link, GPS Rcvr, Accelero-meter	2	Data Rate: 20 Mb/day	Inc 83°-90° Alt 450 km Life 5 yrs Sep 200 km	Orbit Maneuver Every 12 to 60 days	< 1m/s SST < 1 nm/s^2 Accelero-meter
Atm Occult	GPS Rcvr.	1	Data Rate: 20-40 Mb/d			

2.3.3 Descope Options

A cascade of options for descoping the implementation and operations efforts (i.e., a Descope Plan) will be developed during the Mission Definition and Preliminary Design phase. The Descope Plan will provide clarity in terms of how the primary scientific applications will be affected as each descope option is implemented. As a minimum, the Descope Plan will address any reductions in technical accuracy, mission lifetime and science data products. The descope options leading to the minimum science requirements described in Section 2.2 will be defined during the Mission Definition and Preliminary Design phase effort.

3.0 MISSION AND PROJECT REQUIREMENTS

3.1 Mission Cost and Budgetary Requirements

The GRACE mission will be undertaken on a "design-to-cost" basis. As proposed, the mission shall be accomplished with a cost to NASA of no more than $X. Failure to keep the estimated cost to complete the mission at any stage of the development of the mission may be cause for termination. Annual funding will be reflected in contracting vehicles between NASA GSFC and the implementing organizations. Adjustments within the overall "design-to-cost" funding level will be made between years through the normal contracting process. Approval will be sought from NASA for reductions in funding for “opportunity” activities.

3.2 Schedule

The Level-1 schedule milestones are listed below:

Project Requirements Review	Apr 1998
Mission Design & Cost Review	Dec 1998 (or sooner)
Critical Design Review	Mar 1999

Pre-Ship Review	Mar 2001
Internal Progress Reviews	(bi-annual)
Deliver Spacecraft to Launch Site	Jun 2001
Launch	Jul 2001
End of Mission	Jul 2006

3.3 Management System

The mission will establish an effective and efficient management system which will assure that the science objectives can be accomplished within the schedule and cost limitations. As a minimum the following management requirements will be met:

- The GRACE mission will be undertaken on a "design-to-cost" basis;
- All hardware and software will be verified through robust testing;
- Quality assurance program will b e consistent, or exceed, standards set in ISO 9000;
- The Principal Investigator (PI) will exercise overall responsibility for the mission implementation and the leadership of the US Science Team;
- The PI will form and chair a Project Management Team (PMT) which will coordinate all program elements between organizations in both countries;
- The Co-PI will serve as a member of the PMT, lead the European Science Team, and provide management oversight of all German operations in support of this project;
- The Project Manager (PM), acting through JPL, will lead the satellite and system implementation effort, and be responsible for the mission and systems engineering team;
- DLR will be the lead agency for the mission operations effort of this project;
- GFZ will be the lead agency for the launch vehicle of this project

Any requisite modifications to these requirements for Phase C, D and E will be defined during Phase B.

3.3.1 Scheduling

A fully integrated scheduling system will be established and implemented during Phase B to manage all project elements. This system will include the development of network schedules and critical paths. A Level-1 baseline schedule will be developed during Phase B and approved by NASA.

3.3.2 Performance Metrics

A system to measure mission progress will be established and implemented during Phase B which is compatible with the scheduling and cost control systems.

3.3.3 Key Personnel

Changes in the key personnel, defined as the Principal Investigator and the Project Manager, will be subject to NASA approval. The key DARA and DLR personnel will be approved by the respective organizations.

3.3.4 Contract Deliverables

Major contracts which are developed as part of the mission will reflect the science nature of the investigation. As appropriate, deliverables will focus on the science products, and incentive plans will reflect the science deliveries. For this mission, primary emphasis is placed on cost and schedule.

3.3.5 Incentive Fee Plans

Implementation contracts will provide incentives to the contractor for both adherence to cost commitments and technical performance. Subcontracts from JPL for the GRACE Mission are currently in negotiations. Subcontractors include the Johns Hopkins Applied Physics Laboratory, Dornier Satteliten Systeme, Space Systems Loral and ONERA. Upon completion of contract negotiations, a discussion of fee pools and incentive plans will be added to this section.

3.4 Legal Requirements

The Project will abide by all necessary U.S. federal (including NASA), state and local laws and regulations.

3.5 New Facilities

There are no new project specific major facilities required for this mission

3.6 Descope Plan

The PI is responsible, directly and indirectly, through recommendations to the GSFC Mission Manager, for implementing the Descope Plan when it appears that the mission cannot meet its baseline science requirements. If a descope is necessary, the Descope Plan will describe how the Mission will meet the minimum science, budget and schedule requirements.

4.0 MISSION RESPONSIBILITIES

4.1 Principal Investigator and Science Team

The Principal Investigator (PI) will be responsible to NASA for achieving the objectives of the mission. The PI will establish and chair the Project Management Team (PMT) in order to coordinate the elements of the mission being executed by all the participants. The PI shall approve the designation of a single individual as Project Manager at JPL, and shall delegate to this individual the requisite responsibility and authority to manage and administer the effort to implement the GRACE mission. Decisions dealing with mission objectives will be made by the PI, in consultation with the PMT. The PI will also lead the scientific analysis team responsible for data analysis and distribution.

The Co-Principal Investigator (Co-PI), Prof. Dr. Christoph Reigber of GFZ, will be responsible to the PI for oversight of launch and on-orbit operations in fulfilling the mission requirements. He will also provide leadership of the European Science Team.

The Project Manager (PM) shall have delegated to him the requisite responsibility and authority to manage and administer the effort to implement the GRACE mission. This individual shall be the focal point of contact for GSFC. The PM shall ensure that all the objectives associated with the implementation effort are accomplished within schedule and cost constraints, and provide timely reporting of overall progress.

The tasks of the PMT, which consists of the PI, Co-PI, PM and other designated individuals, are to ensure that the program is guided in a responsive manner to maximize the science gains for the mission cost consistent with the constraints of ESSP.

The Science Team will be as described in the Science Requirements sub-section (Section 2.9) of the original proposal. The PI may change the composition of the science team to meet the objectives of the Mission, with notification of such changes to the ESSP Project Office. International participation will be consistent with the NASA/DARA Memorandum of Understanding.

4.2 Industrial Partners

Space System/Loral (SS/L) will perform the satellite system engineering, assembly, integration, and verification testing (AIVT).

The Dornier Satelliten Systeme, GmbH, an affiliate of Daimler-Benz Aerospace (DASA) will initiate the satellite system engineering process in an manner that optimizes the inheritance from Germany's CHAMP Mission, and is responsible for development of the thermal, structural and power systems of the satellites, and will also support launch integration on the COSMOS and launch operations.

4.3 Other Pre-selected Subcontractors

The Applied Physics Lab (APL) at Johns Hopkins University will develop the ultra stable oscillators (USO) to be used for the frequency standards in the SST tracking systems.

ONERA (France) will provide the accelerometers for the two satellites.

5.0 NASA RESPONSIBILITIES

The NASA HQ Code IY will provide support in the development of a Memorandum of Understanding (MOU) with the international partners on the GRACE mission. The GSFC ESSP Project Office will provide mission funding, contract administration and programmatic oversight for the GRACE mission. To implement the GRACE Mission, the ESSP Project Office will provide funds directly to three members of the GRACE Team - UTCSR, JPL and LaRC, as requested by the PI. Furthermore, the ESSP Project Office may provide other mission unique

support, only as may be requested by the PI in writing and agreed upon by the ESSP Project Manager. In the event such support is requested, a portion of the PI's Mission Funds would be retained by the ESSP Project Resources Office, to be disbursed as requested by the PI.

6.0 REPORTING AND NASA REVIEWS

Reporting requirements and NASA reviews will be kept to a minimum while ensuring that NASA maintains an effective understanding of the progress of the development and execution of the mission. To this end, reports and supporting materials will be based on internal Project products and processes to the maximum extent practical. The details will be developed during Phase B between the PI, the Project Manager and the NASA Mission Manager.

NASA reviews will be conducted annually typically in conjunction with major project reviews by a team appointed by the ESSP Project Office to assess the progress of the mission and its readiness to proceed to the next phase. These reviews will assess technical, cost and schedule progress to verify that the project can be completed in accordance with the Level-1 requirements within the cost and schedule commitments. The results of these reviews will be reported to the Earth Science Systems Program Office, (ESSPO), to confirm that the mission shall be continued.

APPENDIX S

Earth Explorers Program Mission Deliverables List
(DRAFT)

1. Project Plan
2. Descope Plan
3. Risk Management Plan
4. Science and Mission Requirements Document
5. Mission Design and Requirements Agreement
6. MOU (if necessary)
7. TAA (if necessary)
8. S/C System Specification
9. Instrument Specification
10. S/W Development Plan
11. S/C to Ground ICD
12. L/V to S/C ICD
13. S/C to Instrument ICD
14. Science Data System Development Plan
15. Outreach Plan
16. Education Plan
17. Mission Operations Plan
18. Mission Operation System Development Plan
19. FMECA
20. Fault Tree Analysis
21. Probabilistic Risk Assessment
22. IV&V Plan
23. System Review Plan
24. Monthly Management Reports
25. Mission Success Criteria
26. Network Schedule
27. Earned Value Report
28. Schedule Slack Report
29. S/W Architectural Design Document